

CONTROL OF HYDROCARBON EMISSIONS  
FROM STATIONARY SOURCES IN THE  
CALIFORNIA SOUTH COAST AIR BASIN



KVB 5804-483

INTERIM REPORT

PRELIMINARY INVENTORY SUMMARY  
FIELD TEST PLAN

CONTRACT ARB 5-1323

PREPARED FOR:

CALIFORNIA AIR RESOURCES BOARD

PREPARED BY:

H. J. TABACK, T. W. SONNICHSEN

N. BRUNETZ, J. L. STREDLER

NOVEMBER 1976

TD  
890  
T3



## ABSTRACT

This report summarizes the results of the preliminary hydrocarbon inventory and presents the detailed plan for source testing. The preliminary inventory which accounts for 6000 point sources plus area source indicates that average daily emission in the South Coast Air Basin and Ventura County is 710 tons per day. Petroleum operations (production, refining and marketing) account for nearly half of these emissions while solvent users account for over 40%. Based on this preliminary inventory a list of candidate sources to be tested is presented. Testing began in November 1976 and will continue through April 1977. Emission samples will be collected in borosilicate jars, Tedlar bags and tubes containing activated charcoal. Samples will be analyzed using GC/MS techniques. The charcoal samples will be extracted using carbon disulfide before analysis. Plans for control of data quality and for determination of experimental error are also discussed.



## TABLE OF CONTENTS

<u>Section</u>	<u>Page No.</u>
ABSTRACT	ii
LIST OF FIGURES	v
LIST OF TABLES	vi
1.0 INTRODUCTION AND SUMMARY	1
1.1 Preliminary Inventory	3
1.2 Test Plan	4
1.3 Test Methods	5
2.0 PRELIMINARY INVENTORY	7
2.1 Sources of Organic Emissions	7
2.1.1 Petroleum Operations	7
2.1.2 Use of Organic Solvents	8
2.1.3 Chemical Operations	10
2.1.4 Metallurgical Processes	10
2.1.5 Food and Agricultural Processing	10
2.1.6 Stationary Fuel Combustion	11
2.1.7 Waste Disposal	11
2.1.8 Miscellaneous Sources	11
2.1.9 Natural Sources	11
2.2 Data Sources	12
2.3 Inventory Data Format and Processing	13
2.3.1 Physical Description	13
2.3.2 Inventory Report Processing	14
2.3.3 Possible Expansion Modifications to Existing System	18
2.4 Results	18
2.4.1 Preliminary Inventory by Application	19
2.4.2 Preliminary Inventory by Device Type	20
2.4.3 Preliminary Inventory by Geographical Location	21
2.4.4 Inventory Comparisons	24
2.4.5 Newly Identified Sources	26
2.4.6 Summary of Emissions From Other Sources	35



<u>Section</u>	<u>Page No.</u>
3.0 PHASE II TEST PLAN	36
3.1 Field Test Program	36
3.2 Test Descriptions	39
3.2.1 Petroleum Operations	39
3.2.2 Solvent Use	41
3.2.3 Chemical	45
3.2.4 Metallurgical	45
3.2.5 Food and Agricultural Processing	45
3.2.6 Combustion of Fuels	45
3.2.7 Other Sources	46
3.3 Preliminary Test Schedule	46
3.4 Special Ambient Monitoring Tests	48
3.5 Questionnaires	51
4.0 SAMPLING AND ANALYSIS METHODOLOGY	53
4.1 Equipment	54
4.1.1 Description	54
4.1.2 Basis for Selection	59
4.2 Procedures	65
4.2.1 Field Testing and Sampling	65
4.2.2 Laboratory Analysis	78
4.3 Quality Assurance Program	83
5.0 REFERENCES	97
APPENDIX A - POTENTIAL TEST LOCATIONS	102
APPENDIX B - SOURCE QUESTIONNAIRES	110
APPENDIX C - DATA ACQUISITION FORMS	121





## LIST OF FIGURES

	<u>Page No.</u>
2-1. Daily total hydrocarbon emissions (tons/day).	22
3-1. Illustration of sampling locations at Douglas refinery when wind is blowing directly from the north.	49
4-1. KVB Hydrocarbon Sampling Trains.	55
4-2. Complete hydrocarbon sampling train as set up for a hot combustion source.	57
4-3. TLV sniffer: conversion curves showing relationship of ppm concentrations of various gases to percent LEL equivalents.	64
4-4. Hydrocarbon sampling train configuration for continuous solvent process related sources of high complexity.	68
4-5. Hydrocarbon sampling train configuration for solvent operations in batch operations.	69
4-6. Leak rate and concentration measurement of ambient temperature fittings. High leak rates.	70
4-7. Leak rate by dilution sweep and sampling of ambient hydrocarbon fitting. Low leak rates.	71
4-8. Leak rate measurement and concentration measurement of high temperature fitting.	72
4-9. Hydrocarbon sampling from hot oil or solvent transfer.	73
4-10. Soap bubble detection and temperature evaluation of hydrocarbon fittings.	77
4-11. Sampling trains in QC test with calibration gas.	79



LIST OF TABLES

	<u>Page No.</u>
2-1. Preliminary Inventory by Device Type	15
2-2. Preliminary Inventory by Application Category Average Daily Hydrocarbon Emissions, Tons/Day	17
2-3. Preliminary Inventory Geographic Distribution Average Daily Hydrocarbon Emissions by 10 Km Grid Squares	23
2-4. Currently Available Inventories of Total Hydrocarbon Emissions from Stationary Sources in the South Coast Air Basin, Tons/Day	25
2-5. Existing Major Class I and II Sanitary Land Fill Sites in the South Coast Air Basin	27
2-6. Existing Major Waste Water Facilities in the South Coast Air Basin	29
2-7. Oil Production Statistics of South Coast Air Basin Active Oil Fields	30
2-8. Estimated Breakdown of Acres of Forest Lands in the South Coast Air Basin	32
2-9. South Coast Air Basin Agricultural Acreage Activity - 1971	33
2-10. Agricultural Waste Production in the South Coast Air Basin and Ventura County	34
2-11. Summary of Other Sources of Emissions	35
3-1. Summary of Proposed Field Test Program	38
3-2. Summary of Proposed Petroleum Production Field Test Program	40
3-3. Summary of Proposed Refinery Field Test Program	40
3-4. Proposed Minor Sources to be Tested	43
3-5. Proposed Major Source Test Schedule	47
4-1. Retention Efficiencies of Various Sorbents	61
4-2. Recovery Efficiency of Purge-Thermal Stripping of Selected Analytes	62
4-3. Sorbent Recovery Efficiencies for Normal Alkanes Using Solvent Elution Techniques	62



LIST OF TABLES (Cont.)

	<u>Page No.</u>
4-4. Multiplying Factors for Converting ppm Meter Readings of Hexane-Calibrated Instruments to ppm Concentrations of Other Gases on TLV Sniffer	65
4-5. Test and Sampling Train Configurations by Source Types	67
4-6. Matrix of Laboratory Analysis	82
4-7. Typical Laboratory GC Analysis Report	84
4-8. Quality Assurance Aliphatic Standard	86
4-9. Quality Assurance Aromatic Standard	87
4-10. Quality Assurance Halogenated Hydrocarbon Standard	87
4-11. Quality Assurance Oxygenated Organics Standard	88
4-12. Recovery Studies Using the Aliphatic Standard	89
4-13. Recovery Studies Using the Aromatic Standard	90
4-14. Recovery Studies Using the Halocarbon Standard	91
4-15. Recovery Studies Using Oxygenated Organics Standard	92



## SECTION 1.0

### INTRODUCTION AND SUMMARY

KVB, Inc. has issued this interim report to document the preliminary (Phase I) effort on the ARB-sponsored program, "Control of Hydrocarbon<sup>1</sup> Emissions from Stationary Sources in the South Coast Air Basin (SCAB),"<sup>2</sup> Contract No. ARB 5-1323. The objectives of the program are to inventory the organic-compound emissions by specie, assess the potential for reduction of these emissions, and predict emission trends through 1985. The final inventory is to quantify the emission of each specie and to provide a breakdown of these emissions by device type, application category, geographic location and winter/summer variations.

The approach taken by KVB was to (1) prepare a preliminary inventory and test plan; (2) conduct field tests to confirm or correct the emissions determined in the preliminary inventory and obtain representative emission profiles (compositional breakdown in weight percentages); and (3) obtain cost and efficiency data on existing control methods to identify the cost effectiveness of applying controls to the various source types identified in the inventory.

The purpose of the preliminary inventory was to identify the point and area emission sources and the magnitude of their emissions. In addition, the distribution of these emissions into application and device-type categories and an assessment of these categories with regard to availability of emission rate data would provide an important basis for selecting the sources to be tested in the Phase II field testing program. Also, the sorting of these

---

<sup>1</sup>On this program, "hydrocarbon" has been interpreted to include all organic compounds.

<sup>2</sup>The SCAB was redefined in June 1976 and now excludes Ventura County. This study, however, will include Ventura County emissions as originally proposed prior to the redefinition.

emissions into geographical locations would be the primary method for reporting area emissions as well as providing preliminary information for air quality modeling by the ARB or others. Although the Phase I effort involved the investigation of general classes of organic compounds emitted by various sources for the purpose of test planning, the preliminary inventory was performed on a total hydrocarbon basis. Finally, a comparison of the KVB preliminary-inventory summary data with those of other published inventories would identify any anomalies that might exist in emission source categorization and in emission data sources so that these could be resolved during the field testing phase.

The purpose of the test plan was to define the sources to be tested and to specify the field sampling, laboratory analysis and data quality assurance procedures to be employed. Since only a small fraction of the total number of sources in the basin could be tested, the sources selected for testing and the extent of testing at each source was based primarily on confirming existing total-hydrocarbon emission factor and measuring the compositional profile of the emissions based on GC/MS analysis. Emphasis was placed on those source categories where absence of information or anomalies were identified in the preliminary inventory or elsewhere in the literature.

In the development of measurement methodology KVB and their subcontractors, Analytical Research Laboratory Inc. (ARLI), conducted a program to:

1. Evaluate various sampling and analysis methods for emission species determination and select the best ones on the basis of both laboratory and field testing
2. Establish a preliminary estimate of experimental error expected in employing the selected methodology
3. Define a quality control program for use during the Phase II field testing program.

This report presents the summary results of the preliminary inventory, the Phase II test plan and the methodology to be used in making the Phase II emission measurements. The preliminary inventory itself, in the form of a



comprehensive computer printout, was transmitted separately to the ARB on November 5, 1976. Although the date of this report is November 1976, its release was delayed until January 1977 by availability of certain data tabulations in Section 4.0. An oral presentation of the information contained in this report was presented to the ARB on November 12, 1976 at their El Monte facility.

#### 1.1 PRELIMINARY INVENTORY

The preliminary inventory accounted for over 6000 devices within the SCAB plus Ventura County. The total hydrocarbon emissions for each plant were examined and a record was created for each device type (i.e. storage tanks, spray booths, etc.) provided the total emissions from devices of that type exceeded 10 tons/year. If a plant contained at least one device type exceeding 10 tons/year, then records were created for all device types in the plant regardless of their emissions levels provided that they were under permit to the SCAPCD. Each record or line entry in the inventory represented the total-plant emissions for a device type. The number of individual devices of a given type was noted on each record. Therefore, only 2400 records were required to represent the 6000 devices in the inventory.

All hydrocarbon-emitting devices under permit to the APCD's were included in the inventory. The emissions from those devices, not included in the 6000 listed as major point source, were included as area emission.

The fields used for the inventory report generation were plant identification number (APCD's), device code (APCD's), application category (ARB's), number of devices, total emissions (tons/day and tons/year), Universal Transverse Mercator (UTM) x and y coordinates, and county code. These data were aggregated by UTM coordinates to produce the Location Report; by device code to produce the Device Report; and by the ARB's application categories to produce the Application Report.

In addition, a Plant Identification Report was generated which provided two listings of plant ID No., plant name, address, and UTM coordinates. One listing was in ID number order and the other was in alphabetical order by plant name.

The results of the preliminary inventory indicated that the total emissions of organic compounds were 710 tons per day on an annual daily average basis for the SCAB and Ventura County. Over 90% of these emissions are concentrated in LA County. The largest source category of organic emissions was found to be Petroleum Operations composed of Refining (21% of the total organic emissions) and Marketing (27%). Organic solvent use, especially Industrial (15%) and Architecture (15%) Surface Coating accounted for the second largest general category. Other solvent users including degreasing (5%), dry cleaning (4%) and printing (3.5%) accounted for the third largest group. These three groups comprised approximately 90% of the annual organic compound emissions. Results of the preliminary inventory showed no major discrepancies when compared with previous inventories on an overall basis. However, some details of application or device distribution will require clarification prior to finalizing the inventory, especially as relates to petroleum refining operations.

An important aspect of the preliminary inventory was the identification of sources of organic compound emissions which are not on APCD permit and therefore not generally accounted for in previous inventories. These included solid and liquid waste disposal sewage treatment operations, petroleum production operations, natural gas transfer, commercial and domestic solvent use and natural emissions. Each of these is discussed in this report.

## 1.2 TEST PLAN

A test plan was developed for Phase II based on the preliminary inventory results. The plan included several days of testing at each of 24 major industrial sites representing a cross section of the industrial sources that emit organic compounds to the atmosphere and the control device currently in use. Shorter test programs are planned for numerous smaller sources as time permits. A priority class for these smaller sources has been established. Phase II activities will also include the coordination and data acquisition from several programs investigating specific aspects of organic emissions such as the Western Oil and Gas Association programs for floating roof tanks, fixed roof tanks and tanker loading emissions; the EPA program on refinery emissions; the state's task force on solvent emissions; the San Diego APCD's program on

gasoline-marketing vapor recovery; and the state's Outer Continental Shelf Programs. The test plan has been organized to assist and complement these efforts whenever possible.

As originally proposed, it is planned to characterize the composite emissions of one refinery using ambient-sampling and plume-modeling techniques. The tests will be conducted on the Douglas Oil Company refinery in Paramount by KVB's subcontractor, AeroVironment Inc. (AV). Emission rates determined in this manner will be compared to those determined by KVB on the basis of individual source emissions. KVB will be performing source tests at the same time AV will be taking ambient samples. A second source characterization by ambient measurement techniques may be conducted if the results of the Douglas Refinery tests are encouraging. The details of a second test have not been planned.

### 1.3 TEST METHODS

In the field test program of Phase I, a universal sampling was designed and fabricated. Calibration, quality control and system optimization were performed to determine the limitations and accuracy for collection efficiency. Field samples will be collected in borosilicate glass bottles, Tedlar bags (for light compounds  $C_1$  to  $C_6$ ) and charcoal sorbent tubes (for compounds  $C_6$  and up). The charcoal tubes are commercially-available, NIOSH, personnel-exposure sampling tubes as used in ambient air samplers carried by industrial employees exposed to potentially toxic substances. Generally, one bottle/bag sample and one sorbent sample will be obtained on each source. The sampling train contains a particulate trap which removes solid and liquid particles greater than 2.5 microns. Thus the samples collected are essentially all gaseous. The filter will be heated for all hot sources to eliminate condensation of organic vapors. Where appropriate, samples will be collected in evacuated bulb flasks containing 1% sodium bisulfite solution for aldehyde determinations. In addition, a continuous-reading, total-hydrocarbon analyzer will be used to provide a double check on lab results and to provide process fluctuation data.

A comprehensive quality assurance plan will be implemented for the field test program incorporating (1) interlaboratory check analyses, (2) calibration of instruments, (3) unannounced blank samples, (4) calibration-gas samples substituted for field samples, and (5) simultaneous duplicate sampling of major source types. Based on Phase I results, sampling and analysis procedures have been developed which could achieve a measurement error range as low as  $\pm 20\%$  although the actual error range will be determined at the end of Phase II. Although some individual data points might be in error by more than  $\pm 20\%$ , the error in the inventory totals should be an order of magnitude lower than that in the individual entries because of random compensation.

## SECTION 2.0

### PRELIMINARY INVENTORY

#### 2.1 SOURCES OF ORGANIC EMISSIONS

Organic compounds are emitted as a result of numerous man-made and natural activities. This study is concerned primarily with the investigation of emissions from stationary man-made sources especially those to which control methodologies can be applied and with a lesser emphasis on natural sources.

Stationary sources of organic compounds can be grouped into several major categories. These include petroleum operations, the use of organic solvents, chemical and metallurgical operations, food and agricultural processing, fuel combustion, waste disposal and other miscellaneous activities. Brief descriptions of the sources, composition of organic emissions, and possible control devices are presented in the following sections.

##### 2.1.1 Petroleum Operations

All petroleum operations, including production, transportation, refining and marketing emit significant quantities of organic compounds. Potential emission sources from petroleum production activities include fugitive losses from ground seepage, pumping, recovery and separating operations and storage losses. Transfer from the production site to the refinery discharges organic vapors through leakage and displacement. Petroleum refining equipment and processes that produce organic emissions include leakage from seals and valves, catalytic processing, separators, blowdown systems, loading operations and storage. Petroleum marketing systems emit organic compounds from tanker loading, service station and automobile tank filling operations.

Of these sources, storage and transfer operations are potentially the most important sources. Vapors are emitted from storage tanks in several fashions. Fixed roof tanks expel organic compounds due to diurnal temperature

variations and the associated expansion and contraction of the vessel that cause the tank to "breathe". Working losses are due to the vapor displacement during tank filling. These losses are also experienced during all other uncontrolled transfer operations. Significant losses are also experienced due to evaporation.

Control devices that can be employed to reduce emissions include floating roof tanks, vapor recovery systems, flares, improved maintenance on pump and valve seals, absorption units and submerged fill devices.

#### 2.1.2 Use of Organic Solvents

Industrial, commercial and domestic uses of organic solvents can be grouped into several categories including surface coating applications, degreasing and dry cleaning operations, printing and the manufacture of rubber, plastic and pharmaceuticals. All solvents are eventually evaporated to the atmosphere either inadvertently or by design. Unless a chemical change occurs to the solvent during the process, the composition of the emissions will be identical to the solvent composition. This has been the basis for nearly all previous estimates of emissions from these sources. Changes can take place through chemical reaction, however, due to polymerization the use of catalysts and direct fired baking ovens.

Surface coating operations account for the largest share of organic solvent consumption. These include oil paints, varnishes, thinners, and low solvent content (water-based) coatings. Solvents are used as vehicles to dissolve the resinous film-forming material in non-convertible coatings and as a reaction medium for convertible coatings. Solvents used in most surface coatings can be classified as aliphatic and aromatic hydrocarbons, alcohols, ketones, esters, halogenated hydrocarbons, or a mixture of these categories. Control devices commonly employed in industrial surface coating applications include condensation, adsorption and incineration. Reformation to lower solvent content or non-reacting base has been employed in both industrial and architectural operations.

Degreasing involves the use of inorganic solvent to dissolve and remove grease and oil from metal parts prior to plating, painting or further processing. Degreasing operations are classified as either cold solvent cleaning or vapor degreasing. The former utilizes solvents at or near room temperature while the latter operates with the solvent heated to its boiling point and the metal processed in a vapor mist. Halogenated and nonhalogenated solvents are used in cold cleaning whereas only halogenated solvents are used in vapor systems due to their nonflammability and high densities. Control techniques include freeboard chillers, carbon adsorption and improved operating practices.

Cleaning textiles with organic solvents is generally termed "dry cleaning". The two types of dry cleaning processing employ either petroleum solvents or chlorinated synthetic solvents. Chlorinated synthetic solvents are used almost exclusively in commercial operations because of safety and lower reactivity. Use of petroleum solvents is generally limited to large industrial operations. Paraffins and naphthenes account for the great majority of the petroleum solvent composition while the primary synthetic solvent is perchloroethylene. Potential control devices include adsorption and condensation systems.

Printing accounts for another significant use of organic solvents. Numerous solvents are employed including various aromatics, aliphatics, oxygenates and modified paraffins. Control techniques include reformulation and carbon adsorption.

Solvents are also used in the manufacture of rubber, plastic and pharmaceutical products. In the rubber and plastic industries, ingredients were added to produce the desired properties in the final product and are released as vapors during curing operations. Examples of organic pollutants from these processes include aromatic amines and diamine derivatives, naphthylamines and ketone-amine products. Solvents released from drug manufacture include a broad range of materials from esters to biological oils. Control methods include reformulation, adsorption and incineration.

### 2.1.3 Chemical Operations

The major conversion reactions employed in the petrochemical processing include alkylation, hydrogenation, dehydrogenation, dehydration, esterification, halogenation, dehalogenation, oxidation, nitration, and polymerization. In each of these processes, a conversion takes place transforming the raw materials, primarily benzene, naphthalene, creosote oil, toluene and xylene into synthetic products with desired properties. The major sources of organic emissions from these conversion processes include leakage from feed and product transfer lines, storage waste gases and distillation columns, and could consist of either raw materials or products. The manufacture of paints, lacquers and varnishes releases organic compound emissions during the formulation process and in the handling and storage of raw materials and intermediate products. Condensers, after-burners and reformulation are the primary control techniques.

### 2.1.4 Metallurgical Processes

The primary source of organic compound emissions associated with the primary metals industry is in the production of coke. These emissions occur during the charging of the coal into the coking oven, as leakage from the oven during the carbonization period and when the coke is quenched and removed from the oven. Little quantitative data on organic emissions are available. Reduced emissions are generally achieved by improved coke-oven design and operating practices.

### 2.1.5 Food and Agricultural Processing

Many food processing operations result in organic compound emissions. These include the manufacture of fermented beverages, deep fat frying, coffee roasting, fish and perishable food canning, and meat packing and rendering. Emissions from these processes generally result from the oils and fats present in the foods or cooking medium. Condensers and after-burners are the primary control techniques.



#### 2.1.6 Stationary Fuel Combustion

Incomplete combustion can result in the release of organic compounds. However, this is generally not a large source of emissions. Compounds emitted from combustion sources include aldehydes (including formaldehyde and acetaldehyde), ketones and organic acids. Other sources associated with combustion processes include fuel storage and transfer operations. Control techniques include improved equipment design, operating practices and fuel substitution.

#### 2.1.7 Waste Disposal

Incineration and open burning are used to reduce the volume of wastes produced from agricultural activities, forest management, range improvements and municipal refuse. Organic compound emissions are very complex and can include organic acids, paraffins, aldehydes, oxygenates and alcohols.

Land fill operations and sewage treatment operations also produce organic emissions. These result from biological decomposition of waste matter in land fill operations and sludge digestion in sewage treatment operations, both of which generate a methane rich gas. Incineration, recovery and improved design have been employed to reduce emissions.

#### 2.1.8 Miscellaneous Sources

Miscellaneous area sources include forest and grassland wild fires, structural fires, various farming operations, including field operations, feed lots and fertilizer use.

#### 2.1.9 Natural Sources

Numerous natural sources of organic compound emissions have been identified. These include anaerobic bacterial decomposition of organic matter in lakes and soils, odors from animal wastes and volatile emissions from plants. While the primary specie identified has been methane, other highly volatile products including terpenes and ethylene are emitted from specific sources.

## 2.2 DATA SOURCES

As a basic approach to conducting this program, maximum use was made of data available as published information or contained in the files of public agencies, utilities and industries.

By virtue of its broad and active area of responsibility and the advanced state of organization of its emissions inventory data, the Southern California APCD Metro Zone was the prime source of data for the preliminary inventory. The SC APCD Metro Zone has approximately 35,000 issued active permits and has processed information for most of these permit units into an electronic data processing (EDP) system. The EDP data file was obtained from the SC APCD in tape form and was computer processed. The tape file contains the following data on each device.

- . operating company name, plant address, location on a one-mile grid
- . device category classification
- . operating hours each day of the week
- . pollutant emission rates (in lb/hr)

The initial search revealed that of the approximately 25,000 permits units recorded on the tape, approximately 16,000 were recorded as being hydrocarbon emitters. In an attempt to keep the number of units inventoried as individual devices to a more manageable number, and yet account for the great majority of the emissions, a cut off of 10 tons/year of total hydrocarbon was employed. The sum of the emissions from the SC APCD devices emitting in excess of 10 tons/year was found to account for approximately 80% of all the hydrocarbon emissions of the Metro Zone EDP emission inventory, and hence was adopted as a pragmatic cutoff for point sources. All minor sources (less than 10 tons per year) at the same location as a large source were similarly recorded as point sources. All other minor sources were grouped as area sources.

Similar identification, device characteristics and emission rate data were also obtained from the SC APCD's files for Orange, Riverside and San Bernardino and from the Ventura County APCD files. In addition, a

limited quantity of fuel use data was obtained, primarily for utilities and a few singularly large industrial sites. As in Los Angeles, information was obtained only for devices on permit. Other devices of interest, not being on permit, could not be identified from various APCD files.

Finally, with respect to the determination of area distributed hydrocarbon sources, extensive use was made of demographic data employing 1975 population estimates. The area information pertains primarily to domestic gas fuel use, architectural surface coatings and petroleum marketing which are the significant sources of emissions.

During the preliminary inventory, it became apparent that updated information on solvent use, operational procedures and control equipment installations and modifications will be required to more accurately assess the emission rates for 1975. Questionnaires have therefore been prepared as discussed in Section 3.5. Information gathered is to be subsequently used in compiling the final inventory.

## 2.3 INVENTORY DATA FORMAT AND PROCESSING

As stated in the KVB proposal, the hydrocarbon point source inventory data record format is that of the Environmental Protection Agency's National Environmental Data System (NEDS). The description of this data-recording system is found in Reference 18, EPA "Guide for Compiling a Comprehensive Emissions Inventory." An investigation is being made to convert this to the newer EPA Emission Inventory System (EIS).

### 2.3.1 Physical Description

The preliminary inventory accounted for over 6000 devices within the SCAB plus Ventura County. The total hydrocarbon emissions for each plant were examined and a record was created for each device type (i.e., storage tanks, spray booths, etc.) provided the total emissions from devices of that type exceeded 10 tons/year. If a plant contained at least one device type exceeding 10 tons/year, then records were created for all device types in the plant regardless of their emission level provided that they were under permit to the SCAPCD. Each record or line entry in the inventory represented the total plant emissions for a device type. The number of individual devices

of a given type was noted on each record. Therefore, only 2400 records were required to represent the 6000 devices in the inventory.

All hydrocarbon-emitting devices under permit to the APCD's were included in the inventory. The emissions from those devices not included in the 6000 listed as major point sources were included as area emissions.

The data used for the preliminary inventory were an extracted version of the NEDS formatted data. The fields used for the inventory report generation were plant identification (non-NEDS), device code, application category, number of devices, total emissions (tons/year), UTM x and y coordinates, and county code. These data were aggregated by UTM coordinates to produce the location report, by device code to produce the device report and by application category to produce the application report.

In addition, a plant identification report was generated from a name and address data base. The name and address data base contains mailing name and address as well as device location addresses.

### 2.3.2 Inventory Report Processing

In summarizing the data for the inventory, summations are made on three bases: type of device, category of application, and geographical location. The device type sort is made on the basis of the SC APCD device code. Within each device category, the points were listed in descending order of emissions. All sources emitting less than 10 tons/year were summed and reported as minor points. A summary of the more significant device categories is presented in Table 2-1. To make it possible to sort in terms of applications categories similar to those used by the ARB, an application (or user) category classification was devised based upon the SC APCD device coding. Within each application category, the points were listed in descending order of emissions. All sources emitting less than 10 tons/year were summed and reported as minor points. A summary of the more significant application categories is presented in Table 2-2. The geographical sort was made on the basis of the 10 Km grid system adopted which is defined by the even 10,000 meter lines of the UTM coordinate system. Devices obtained from the SC APCD data file were located on a 1-mile grid system and were subsequently transferred to the UTM grid system to an

TABLE 2-1. PRELIMINARY INVENTORY BY DEVICE TYPE

Source Type	No. of Sources	Hydrocarbon Emissions (tons/day)	Percent
PETROLEUM OPERATIONS			
<u>Petroleum Production</u>			
Crude Transfer	6	0.1	---
Crude Storage	180	32.0	4.5
Separation	15	1.2	0.2
Effluent Water Transfer	25	0.6	0.1
Effluent Water Storage	<u>12</u>	<u>0.6</u>	<u>0.1</u>
Total	240	34.0	4.9
<u>Petroleum Refining</u>			
Crude Transfer	3	0.1	---
Crude Storage	116	25.0	3.5
Distillation	55	9.2	1.3
Thermal Processing	12	1.5	0.2
Catalytic Cracking	11	1.2	0.2
Catalytic Reforming	29	1.5	0.2
Misc. Catalytic Processing	15	3.1	0.4
Separation	7	0.1	---
Middle Distillate Transfer	23	1.1	0.2
Middle Distillate Storage	181	5.5	0.8
Misc. HC Transfer	4	0.8	0.1
Misc. HC Storage	83	2.5	0.4
Treating, Finishing, and Blending	28	1.5	0.2
Gasoline Storage	272	27.1	3.8
Gasoline Transfer	21	1.1	0.2
Effluent Water Treatment	28	0.9	0.1
Effluent Water Storage	9	0.4	0.1
Misc. Petroleum Operations	<u>18</u>	<u>0.6</u>	<u>0.1</u>
Total	915	83.0	11.8
<u>Petroleum Marketing</u>			
Middle Distillate Transfer	20	0.7	---
Middle Distillate Storage	173	10.8	1.5
Misc. HC Transfer	12	2.3	0.4
Misc. HC Storage	38	1.7	0.2
Gasoline Storage	147	10.5	1.5
Tanker Truck Loading	40	34.0	4.8
Underground Storage Filling	8,500	60.0	8.5
Vehicle Filling	<u>8,500</u>	<u>96.0</u>	<u>13.7</u>
Total	17,400	220.0	30.5
Petroleum Operations Total	<u>18,500</u>	<u>340.0</u>	<u>47.3</u>

TABLE 2-1 (Cont)

Source Type	No. of Sources	Hydrocarbon Emissions (tons/day)	Percent
ORGANIC SOLVENT USERS			
<u>Surface Coating</u>			
Spray Booths	1,600	72.0	10.3
Other Spraying	84	11.9	1.7
Flow Coater	58	5.2	0.7
Roller Coater	74	3.8	0.5
Dip Tank	64	2.3	0.3
Drying Oven	190	4.5	0.6
Baking Oven	360	3.6	0.5
Continuous Oven	45	3.4	0.5
Architectural Coatings	--	103.0	14.6
Total	2,500	210.0	29.8
<u>Degreasing</u>			
Trichloroethylene	14	0.4	---
Other	290	31.6	4.6
Total	310	32.0	4.6
<u>Dry Cleaning</u>			
Petroleum	43	6.7	1.0
Synthetic	--	24.3	3.4
Total	43	31.0	4.4
<u>Printing</u>			
Flexographic	83	6.9	1.0
Rotogravure	17	17.2	2.4
Miscellaneous	20	0.9	0.1
Total	120	25.0	3.5
Organic Solvent Subtotal	2,900	300.0	42.3
CHEMICAL PROCESSING			
Cosmetic Pharmaceutical Equipment	7	0.2	---
Rubber	88	0.8	0.1
Misc. Chemical Treating	220	9.4	1.3
Misc. Chemical Storage	120	1.6	0.2
Chemical Processing Subtotal	440	12.0	1.7
COMBUSTION			
Boiler	121	12.6	1.8
Turbine	8	0.5	---
Refinery Heaters	310	3.4	0.5
Domestic Heaters	--	3.3	0.5
Combustion Subtotal	500	20.0	2.8
OTHER PROCESSING			
Asphalt	89	1.1	0.2
Food	3	0.1	---
Organic Material	8	0.3	---
Other	380	36.5	5.1
Other Processing Subtotal	490	38.0	5.3
GRAND TOTAL	23,000	710.0	100.0

TABLE 2-2. PRELIMINARY INVENTORY BY APPLICATION CATEGORY  
AVERAGE DAILY HYDROCARBON EMISSIONS, TONS/DAY

Category	Los Angeles County	Orange County	Riverside County	San Bernardino County	Ventura County	Total Area	Total
I. Petroleum Point Sources	128	0	0	0	1.1	207* <sup>]</sup>	340
Area Sources	142	36	8.0	12.0	9.2		
II. Organic Solvent Users	135	8.6	0.4	1.2	4.8	149 <sup>†</sup>	300
III. Chemical	10.8	0.7	<0.1	<0.1	0.3	<0.1	11.8
IV. Metallurgical	<0.1	<0.1	<0.1	1.9	<0.1	<0.1	1.9
V. Mineral	1.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.1
VI. Incineration	0	0	0	0	0	0	0
VII. Combustion of Fuel	14.7	<0.1	<0.1	0.5	1.3	3.3	19.8
VIII. Unclassified	3.7	0.9	<0.1	0.4	<0.1	29.3	34.3
IX. Agricultural	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	0.3
Total	440	46	8.4	16	16.7	390	710

\*92% petroleum marketing all counties

<sup>†</sup> 69% architectural surface coating

accuracy of  $\pm 1/2$  mile. Within a UTM grid, all device records for a given plant are listed together. Other reports could be prepared to format or sort the data base information in any desired manner.

### 2.3.3 Possible Expansion Modifications to Existing System

During Phase I of the current program, the possibility of altering the data format from a NEDS system to an Emissions Information System (EIS) was explored. A description of this data system is found in Reference 2-1. Because reformatting of the data will require an added expenditure of labor and computer time beyond the scope of the original work statement, additional funding will be required to make this alteration. Several other data requirements including smaller grid divisions and complete data on stack parameters have also been proposed by the ARB and this too will require further negotiation.

Plans for Phase II include the development of a Profile Data Base that will contain information on the types and quantities of species being emitted from various classes of devices. The Profile Data Base will be used in conjunction with the emission data contained in the point source data base to obtain quantitative estimates of emission rates of specific organic compound species within the South Coast Air Basin.

## 2.4 RESULTS

A preliminary inventory of hydrocarbon emissions in the South Coast Air Basin has been prepared for the purpose of identifying the major sources, estimating emissions and establishing priorities for the Phase II test program. Preliminary point source emissions have been recorded in computerized format as discussed in Section 2.3. Point source devices have been classified by type of application, type of equipment and geographic location. Computer sorting according to these classifications has formed the basis for the inventory reported in this section.

The inventory is presented in a category format as specified by the ARB to facilitate comparisons with those inventories previously prepared by the local air pollution control districts. Such comparisons should be made with caution. The purpose of an inventory is to identify the significant



sources and estimate, in as practical a manner as possible, the magnitude of emissions. It is invalid to attempt a critical comparison of the total emissions from two separate inventories without a similar critical comparison of the detailed point source estimates for which each inventory was compiled.

Estimates of seasonal variations are not included in this inventory as information on seasonal process variations was not available from the coded APCD data files. This will be included in the final inventory generated by the results of the questionnaires. It is anticipated that industrial sources will show little variation over the year.

As discussed in Section 2.2, these data were prepared from information contained in the local APCD permit files. With the exception of petroleum marketing and architectural surface coating emissions which were generated from study reports, only sources under permit are included in the following inventories. A brief description of estimates from other sources is presented in Section 2.4.5.

#### 2.4.1 Preliminary Inventory by Application

The preliminary inventory of stationary sources sorted by application classification is given in Table 2-2. Sources have been grouped using the categorizing procedures developed by the ARB. Presented are the total daily emissions for all sources within these groups listed in descending emissions order. Point sources, as previously defined in Section 2.3, are also presented for the five counties. Area sources for the entire Basin have been grouped together. In addition to the minor point sources, area sources include gasoline marketing, architectural surface coatings, domestic natural gas combustion, and structural fires, which were all distributed on a population basis.

As shown, petroleum operations account for nearly half of the emissions within the Basin. Of the 337 tons per day total, 207 tons per day or 61% involve area sources primarily gasoline marketing. The balance consisting of the point source emissions are nearly all in Los Angeles County.

Organic solvent use represents the next largest source. Total emissions from all sources within this group are 298 tons per year or 42% of the total. Again, a large share of these emissions can be classified as area sources primarily architectural coatings applied in the field (as opposed to a manufacturing process) and the remainder as point sources in Los Angeles County.

All other classifications account for 69 tons per day or 10% of the total. Of these, small unclassified sources, combustion of fuel and chemical productions are the largest emitters.

#### 2.4.2 Preliminary Inventory by Device Type

The preliminary inventory of sources sorted by device type is given in Table 2-1. Devices have been grouped into general application classes for clarity and consistency with the preceding discussions. Devices were listed in descending order of emissions within a device type.

As previously discussed, petroleum refining and marketing operations emit 337 tons per year. (The refining classification includes all activities related to the storage and transfer operations at production and terminal sites as well as actual refining storage and operation.) Petroleum marketing represents the largest sources of emissions within this classification. Storage accounts for 98 tons per day or 67% of the total emissions from petroleum refinery operations. Petroleum transfer operations and processing account for the balance of the refinery emissions.

Use of organic solvents includes surface coating, degreasing, dry cleaning and printing. Of these, surface coating operations represent the largest source. Architectural coating and spray booths are the most profuse accounting for 103 tons per day and 72 tons per day, respectively. Other types of surface coating and ovens account for a total of 38 tons per day.

Degreasing, dry cleaning and printing each account for approximately 4.6% of the total emissions from all sources. Note that essentially all degreasing operations listed employ solvents other than trichloroethylene, presumably perchloroethylene and 1,1,1-trichloroethane. Perchloroethylene (synthetic solvents) account for approximately 80% of the dry cleaning operations. Rotogravure and flexographic represent nearly all of the organic solvent use in printing operations.

Miscellaneous chemical treatment and storage account for nearly all of the emissions from chemical processing. Rubber processing represents only 0.1% of the total emissions.

Organic emissions from boilers and refinery heaters constitute the bulk of emissions from combustion devices, accounting for 12 tons per day. Refinery heaters and domestic heaters each represent approximately 3 tons per day or 0.4% of the total.

#### 2.4.3 Preliminary Inventory by Geographic Location

The emissions from point and area sources within the Basin have been determined for 10 kilometer square grids defined by the UTM coordinate network. The resultant annual total organic compound emission distribution is presented in Figure 2-1.

As shown, twenty-two grids have total organic emissions greater than 10 tons per day and constitute 70% of total emissions in the Basin. These are located in central and south Los Angeles County and in central Orange County.

Table 2-3 lists these major grid squares ordered by daily emissions. The major city in each grid is indicated and the type of major source is noted for each. It is apparent that the squares with the largest emissions are those with refineries, major printing or surface coating operations.

Geographic distribution data can be useful input to meteorological models that assess emission distribution as a function of source location and various atmospheric parameters. It is believed that a 10-Km grid distribution provides sufficient detail for such an analysis involving area sources. Major point sources will require a more detailed location determination possibly to 1 Km grid. Such a precise positioning is beyond the scope of this effort but has been proposed as an added scope item (see Section 3.0).

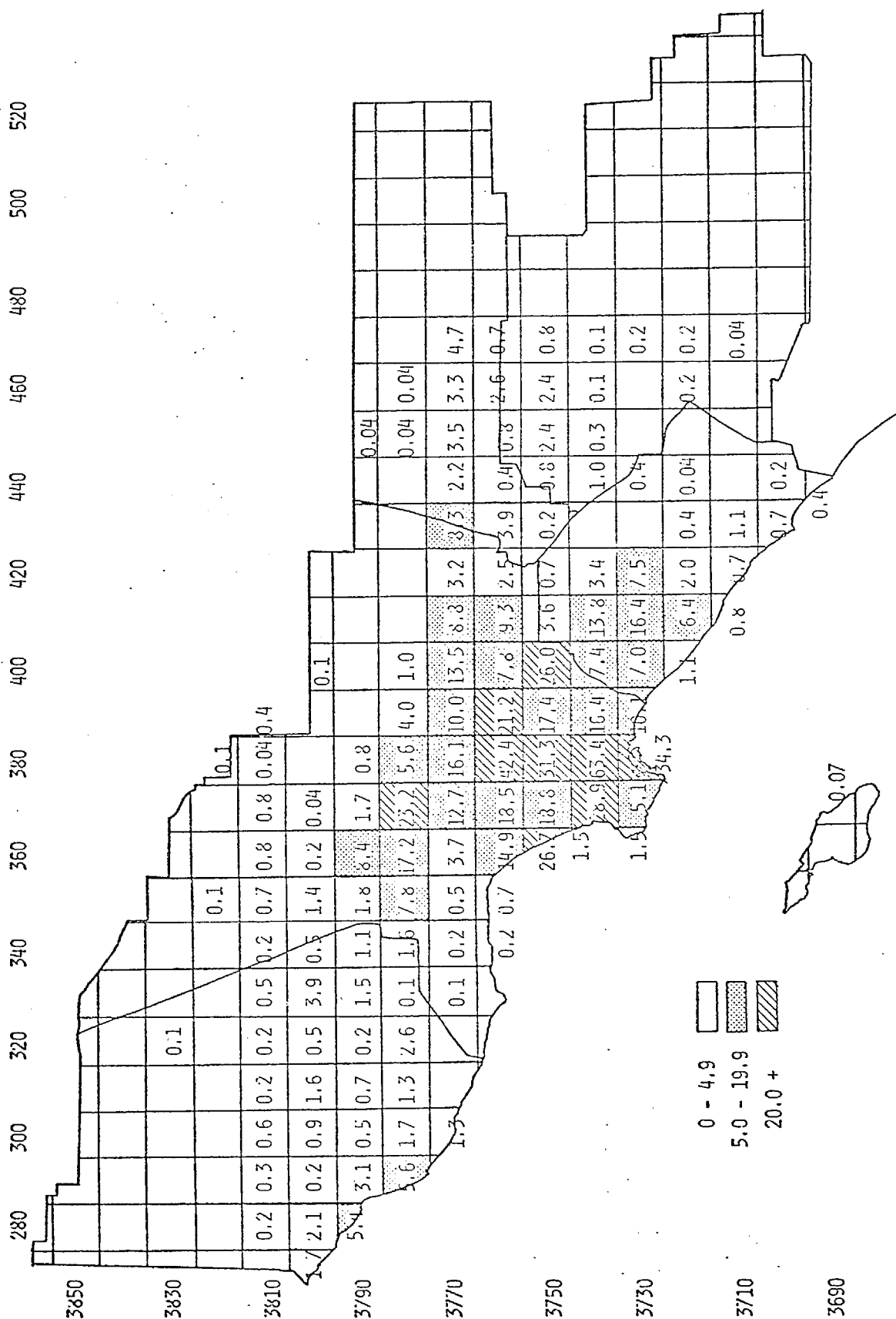


Figure 2-1. Daily total hydrocarbon emissions (tons/day).

KVB 5804-483

TABLE 2-3. PRELIMINARY INVENTORY GEOGRAPHIC DISTRIBUTION  
AVERAGE DAILY HYDROCARBON EMISSIONS BY 10 KM GRID SQUARES

Grid UTM Coordinates		Major City	Hydrocarbon Emissions (Tons/Day)	Major Source Types
S	W			
380	3,740	Paramount	63.38	Refinery, Surface Coaters, Chemical
380	3,730	Downtown L.A.	42.37	Printing and Surface Coaters
380	3,750	L.A. Harbor	34.30	Petroleum Refinery and Transfer
380	3,750	Watts	31.31	Automotive Assy and Tire Mfg.
370	3,740	Torance	28.91	Refinery
360	3,750	L.A. International	26.74	Refinery
400	3,750	Whittier	26.00	Refinery
370	3,750	Burbank	23.22	Printing and Power Plant
390	3,760	Monterey Park	21.15	Packaging and Tire Mfg.
370	3,750	Hawthorne-Inglewood	18.84	Petroleum Marketing
370	3,760	Culver City	18.49	Petroleum Marketing
390	3,750	Downey	17.42	Petroleum Marketing
560	3,780	Sepulveda	17.15	Automobile Assy and Petroleum Marketing
390	3,740	Lakewood	16.39	Aircraft Mfg. & Petroleum Marketing
410	3,730	Santa Ana	16.38	Petroleum Marketing and Surface Coating
380	3,770	Glendale	16.11	Power Plant and Petroleum Marketing
360	3,760	Santa Monica	14.89	Petroleum Marketing
410	3,740	Anaheim	13.80	Petroleum Marketing and Surface Coating
400	3,770	Arcadia	13.49	Packaging and Petroleum Marketing
370	3770	W. Hollywood	12.72	Petroleum Marketing
390	3,730	Long Beach	10.14	Power Plant, Petroleum Marketing
390	3770	Pasadena	10.04	Petroleum Marketing

KVB 5804-483

#### 2.4.4 Inventory Comparisons

Comparisons between inventories are subject to numerous qualifications. The necessity of a critical comparison of not only the overall emission levels but also the basis for these estimates has already been discussed in Section 2.4. Furthermore, when inventories are segregated into arbitrary application groups, the definition of which group a device or plant rightly belongs may be unclear. In addition, with respect to the current study, differences may arise as to the geographic area of interest. (The current study is concerned with the presently defined South Coast Air Basin and Ventura County, an area which does not directly compare with any other known study.) Therefore, direct comparisons of various inventories must not lead to unwarranted conclusions regarding the differences between the broad groups presented but can give useful information as to the absolute magnitude of the total emissions.

With these cautions in mind, Table 2-4 presents a comparison of recent inventories generally covering the study area. Currently available inventories for stationary sources include those compiled by the ARB (Ref. 2-2), an inventory of emissions for the entire state of California prepared for EPA by Pacific Environmental Services (Ref. 2-3), county inventories prepared by the APCD's for each of the five counties (Refs. 2-4 to 2-9), and a recent study of reactive hydrocarbon emissions conducted for EPA by TRW (Ref. 2-10).

These inventories, together with the present inventory summarized in Table 2-4, indicate that the total organic compound emissions from Basin stationary sources are between 700 to 800 tons/day, with the exception of the EPA/PES survey indicating only 300 tons/day. The close agreement of the other inventories would be expected as they are all essentially derived from the county APCD data which includes all permitted devices whereas the EPA/PES survey was primarily directed to include only sources over 100 tons/year and is therefore not complete.

TABLE 2-4. CURRENTLY AVAILABLE INVENTORIES OF TOTAL  
HYDROCARBON EMISSIONS FROM STATIONARY SOURCES IN THE  
SOUTH COAST AIR BASIN, TONS/DAY

Source	Calif. ARB	EPA/PES <sup>†</sup> (NEDS)	County APCD's	EPA/TRW	KVB/ARB Preliminary Inventory
Area Covered	SCAQMA 1974	SCB 1972	SCB+Ventura 1974/75	SCB 72-74	SCB+Ventura 1975
PETROLEUM					
Production	61	44	32	62	34
Refining	48	28	48	50	23
Marketing	154		165	152	220
Subtotal	263	72	245	264	340
ORGANIC SOLVENTS					
Surface Coating	166	118	165	143	210
Dry Cleaning	29	23	26	41	31
Degreasing	39	26	31	106	32
Other	175	36	172	129	25
Subtotal	409	203	394*	477	300
CHEMICAL			(3)*	58	12
METALLURGICAL	3				2
MINERAL	1				1
FOOD/AGRIC.			(5)*		1
PESTICIDES	9		(12)*		
COMB. OF FUEL				23	
Power Plants	8	19			13
Other	14	4			7
Subtotal	26	23	(10)*	23	20
WASTE	2		(24)*	41	2
MISC. AREA	64	10	(4)*		34
SCB TOTAL	799	308	770	805	710

\*Values in parentheses are for all counties except Los Angeles; breakdown by industry not available for Los Angeles.

<sup>†</sup>Includes only sources greater than 100 tons/year.

From these inventories, it is clear that the largest sources of total organic compound emissions are petroleum operations and organic solvent use. Specifically, general agreement has petroleum marketing and surface coating comprising 150 to 200 tons/day each or approximately 50% of the total emissions.

The KVB/ARB estimate for petroleum refining and marketing operations generated for the preliminary inventory is larger than in any of the previous inventories. As discussed in Section 2.2, the estimate for petroleum refining operations was taken from the SCAPCD permit files and therefore better agreement would be expected. No apparent explanation is available for this discrepancy. Further investigation of this area will be made before the final inventory is completed. A similar situation is evident for petroleum marketing operations. These figures, however, are highly dependent on the emission factors used for estimating tanker truck loading, gasoline station marketing, and automobile tank filling emissions. This difference is being investigated further and will be resolved for the final inventory.

Differences between the current and previous inventories were also evident in the estimates for organic solvent use. The higher figures of organic solvent surface coating emissions given in Table 2-4 was due entirely to recent increases in the estimates for architectural surface coatings, especially for domestic use. No justification for the relatively large estimates in the "other" classification could be justified on the basis of the data obtained by KVB for the current inventory. General agreement regarding the minor sources including dry cleaning and degreasing operations is shown in Table 2-4 for all inventories.

#### 2.4.5 Newly Identified Sources

An important aspect of the preliminary inventory was the identification of sources of organic compound emissions not under permit and generally not included or adequately characterized in previous inventories. These sources include solid and liquid waste disposal in land fill sites, sewage treatment operations, petroleum production operations, natural gas transfer with the basin, domestic and solvent use, and natural emissions from forests,



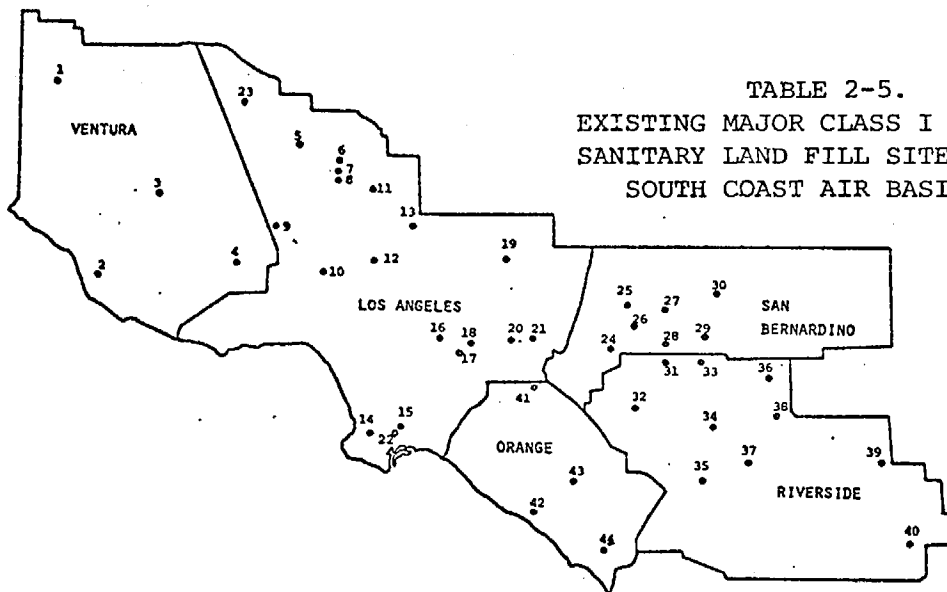


TABLE 2-5.  
EXISTING MAJOR CLASS I AND II  
SANITARY LAND FILL SITES IN THE  
SOUTH COAST AIR BASIN\*

Quantity of		Reported	Tons/Year	
Waste Received	Class	Acres	Liquid	Solid
Total				
<b>Ventura County, October 1975</b>				
1. Ozeha	II	-	1,086	1,086
2. Santa Clara	II	47	434,400	434,400
3. Toland Road	II	120	36,200	36,200
4. Simi	I	230	144,800	144,800
All Other Class II Sites		460	167,400	167,400
Total		457		783,886
<b>Los Angeles County, September 1974</b>				
5. N. Valley Refuse Center	II	230	-	550,000
6. Bradley Avenue Dump	II	63	-	332,000
7. Penrose Pit	II	73	-	398,000
8. Hewitt Pit	II	117	-	436,000
9. Calabasas Land Fill	I	416	36,000	320,000
10. Mission Canyon Land Fill	II	1,491	-	1,394,000
11. Burbank City Land Fill	II	133	-	75,000
12. Toyon Canyon Land Fill	II	40	-	795,000
13. Scholl Canyon Land Fill	II	484	-	450,000
14. Palos Verdes Land Fill	I	295	280,000	1,300,000
15. Ascon	II	65	85,000	422,000
16. Operating Industries	II	190	177,000	589,000
17. City of Whittier Land Fill	II	117	-	107,000
18. Puente Hills Land Fill	II	1,214	17,000	1,165,000
19. Azusa Western	II	307	-	271,000
20. B.K.K. Land Fill	I	583	254,000	352,000
21. Spadra Land Fill	II	199	13,000	192,000
22. Harbor Dump	II	25	-	160,000
23. Chiquita Canyon Land Fill	II	40	-	33,000
All Other Minor Class II Sites		N.R.	-	56,050
Total		6,082	862,000	9,341,000
<b>San Bernardino County, January 1974</b>				
24. Milliken	II	106	-	215,500
25. Cajon	II-2 <sup>1</sup>	106	1	117,500
26. Fontana	II	82	-	64,000
27. Heaps Peak	II	63	-	16,600
28. Colton	II	94	-	93,700
29. Yucaipa	II	560	-	34,600
30. Big Bear	II	70	-	11,600
Total		1,081		553,500
<b>Riverside County, June 1975</b>				
31. West Riverside	II-2 <sup>1</sup>	63	-	52,700
32. Corona	II-2 <sup>1</sup>	101	-	88,350
33. Highgrove	II-2	280	-	8,100
34. Mead Valley	II-2	240	-	8,100
35. Elsinore	II-2	44	-	12,400
36. Badlands	II-2	904	-	15,500
37. Double Butte	II-2	580	-	61,380
38. Lamb Canyon	II-2 <sup>1</sup>	788	-	48,050
39. Idyllwild	II-2 <sup>1</sup>	30	-	3,010
40. Ansa	II-2	10	-	1,550
Total		3,040		299,140
<b>Orange County, December 1975<sup>2</sup></b>				
41. Olinda	II	235	-	758,000
42. Coyote Canyon	II	593	-	2,130,000
43. Santiago Canyon	II	160	-	374,000
44. Prina DeSchecha	II	945	-	478,000
Total		1,933		3,740,000

GRAND TOTAL . . . . . 11,450

15,579,526

<sup>1</sup> Includes septic tank waste

<sup>2</sup> County sites handle about 99% of the solid waste generated within

NOTE: Unreported liquid - solid waste differentiation reported as solid waste

Source: County Solid Waste Management Plans

In South Coast Air Basin county areas

agricultural activities, livestock and the human population. A brief discussion of the organic emissions from these sources is presented in the following paragraphs. Plans for investigating these sources are included in the general test plan.

A. Land Fill Operations--

As shown in Table 2-5, over 15 million tons of liquid and solid wastes are deposited annually in the 45-day major land fill sites within the basin. Recent studies (Ref. 2-11) concerned with recovering the biogases generated by the biological anerobic digestion of these wastes have shown that up to 12% by weight of these wastes are eventually transformed to organic vapors (primarily as methane). This production rate appears to be highly dependent on the type, liquid content, soil composition, and age of the particular site. Estimates of organic compound emissions from these sources could range to 250 tons/day.

B. Sewage Treatment Operations--

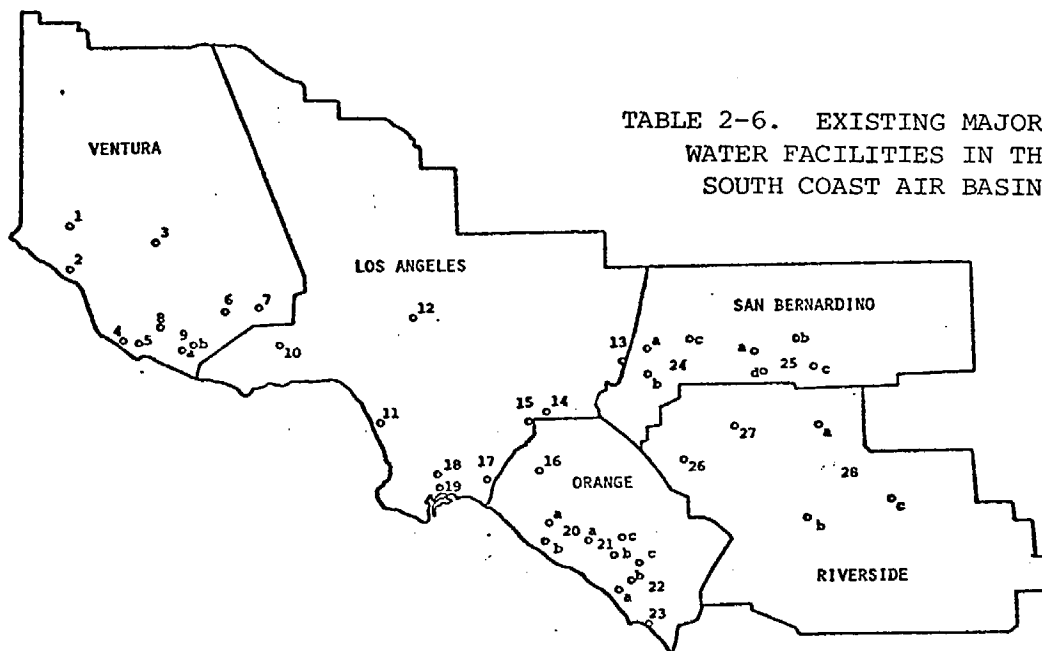
Organic compound vapors are emitted during the processing of liquid wastes in sewage treatment plants. Techniques to reduce uncontrolled gaseous emissions have been developed primarily for odor control and are in common use within the Basin. However, the absolute quantity of emissions from this type of source has never been quantified. Due to the tremendous quantities of water processes in the Basin as illustrated in Table 2-6, this could potentially represent a major source of emissions.

C. Petroleum Production Operations--

The magnitude and composition of organic compound emissions from petroleum production operations are essentially unknown. The emission factors currently in use were developed primarily from petroleum refining operations. No comprehensive field test program on emissions from ground seepage, pumping, recovery and separation operations is known to exist.

As shown in Figure 2-7, extensive petroleum production operations are currently underway in the South Coast Air Basin plus Ventura County. Nearly 152 million barrels of crude oil and 12 billion cubic feet of natural gas were produced in 1975. Again, emissions from this source will be thoroughly investigated as it may represent a source much larger than heretofore was assumed.

TABLE 2-6. EXISTING MAJOR WASTE  
WATER FACILITIES IN THE  
SOUTH COAST AIR BASIN\*



\*Source: Revision to the Area Wide Plan and  
Program for Water Quality Management, Southern  
California Association of Governments,  
December 1974.

Existing County/Treatment Facility in the South Coast Air Basin	Present Waste Flow in MGD	Existing County/Treatment Facility in the South Coast Air Basin	Present Waste Flow in MGD
<u>VENTURA COUNTY</u>		<u>SAN BERNARDINO COUNTY</u>	
1. Oakview Sanitation District	1.5 (Includes Ojai)	24. Chino Basin M.W.D. <sup>2</sup>	18.1
2. City of Ventura	5.0	25. San Bernardino East Valley <sup>3</sup>	20.7
3. City of Santa Paula	1.7	TOTAL	38.8
4. City of Port Hueneme	3.3	<u>RIVERSIDE COUNTY</u>	
5. City of Oxnard	10.0	26. City of Corona	3.2
6. Moorpark County San. District	0.4	27. City of Riverside	20.0
7. Simi Valley County San. District	3.8	28. Eastern M.W.D. <sup>4</sup>	5.1
8. Camarillo San. Dist.	2.6	TOTAL	28.3
9. City of Thousand Oaks <sup>1</sup>	5.6		
TOTAL	33.9		
<u>LOS ANGELES COUNTY</u>		<u>FOOTNOTES:</u>	
10. Las Virgenes MWD	3.5-4.0	<sup>1</sup> Includes two facilities in the city of Thousand Oaks, one with a present capacity of 10 MGD, and the other with a capacity of 1.5 MGD.	
11. City of LA Hyperion Plant	350.0	<sup>2</sup> Includes three facilities: (a) Ontario-Upland Plant, (b) Chino Plant #1, and (c) Fontana Facility.	
12. City of Burbank Reclama- tion Plant	5.5	<sup>3</sup> Includes facilities in the cities of (a) Rialto, (b) San Bernardino, (c) Redlands, and (d) Colton; also a proposed facility in Yucaipa.	
13. Pomona Renovation Plant	8.5	<sup>4</sup> Includes water reclamation facilities in (a) Sunnymead, (b) Sun City, and (c) Hemet-San Jacinto.	
14. San Jose Creek Reclamation Plant	31.0	<sup>5</sup> Includes two facilities: (a) Plant I and (b) Plant II.	
15. Whittier-Narrows Renova- tion Plant	12.0	<sup>6</sup> Includes three facilities: (a) Michaelson Reclamation Plant, (b) Pump Station #1, and (c) Pump Station #2.	
16. Los Coyotes Renovation Plant	9.0	<sup>7</sup> Includes three facilities: (a) Moulton Niguel, (b) South Water District, and (c) Laguna Beach.	
17. Long Beach Renovation Plant	9.0		
18. L.A. Co. San. Dist. J.W.P.C.P.	350.0		
19. Terminal Island Treatment Plant	10.0		
TOTAL	788.8		
<u>ORANGE COUNTY</u>			
20. Orange Co. San. Dist. <sup>5</sup>	127.0		
21. Irvine Ranch Water District <sup>6</sup>	3.6		
22. Los Alisos Water Management Agency <sup>7</sup>	7-8		
23. SERRA	3.5		
TOTAL	186.6		

TABLE 2-7.  
OIL PRODUCTION STATISTICS OF SOUTH COAST  
AIR BASIN ACTIVE OIL FIELDS

<u>Field Area and Pool</u>	<u>Oil Produced bbl/yr -1974</u>	<u>Average of Producing Gas Wells, 1974, 10<sup>6</sup> ft<sup>3</sup>/yr</u>
-- <u>Ventura County</u> --		
1. Ojai oil field	1,211,717	119
2. Sespi	1,114,344	172
3. Rincon - onshore	2,892,128	243
4. San Kiguelito	1,420,613	63
5. South Mountain	1,650,122	437
6. Ventura	11,049,525	829
All Others	3,782,459	760
County Total	<u>23,120,408</u>	<u>2,623</u>
-- <u>Los Angeles County</u> --		
7. Beverly Hills	4,668,904	129
8. San Vincente	1,275,841	33
9. Las Ciengas	1,923,670	79
10. Inglewood	3,586,732	437
11. Dominguez	1,147,158	133
12. Torrance	2,779,977	363
13. Wilmington	65,335,801	2,326
14. Long Beach	2,507,326	641
15. Coyote, West	2,162,113	159
16. Brea Olinda	3,431,975	730
All Others	5,330,491	1,067
County Total	<u>94,149,988</u>	<u>6,097</u>
-- <u>Orange County</u> --		
17. Seal Beach	1,247,541	178
18. Yorba Linda	3,687,109	484
19. Richfield	1,491,934	260
20. Huntington Beach-onshore	4,070,830	814
21. Newport Beach West-onshore	1,372,029	215
All Others	22,128,061	1,271
County Total	<u>33,997,504</u>	<u>3,222</u>
-- <u>Riverside County</u> --		
County Total	62,046	13
-- <u>San Bernardino County</u> --		
County Total	179,054	40
GRAND TOTAL . . . . .	<u>151,997,504</u>	<u>11,995</u>

D. Natural Gas Transfer--

The Southern California Gas Company and the Gas Department of Long Beach report that over 656 billion cubic feet of natural gas were consumed in the South Coast Air Basin in 1975 by utility, industrial and domestic consumers. SCGC officials estimate that approximately 2 billion cubic feet of this is lost to the atmosphere prior to consumption. This represents 136 tons per day consisting primarily of methane. Continued discussions with the suppliers of natural gas will be conducted during Phase II to more accurately assess these emission levels.

E. Domestic Solvent Use--

Estimates of domestic surface coating organic compound emissions based on survey data generated by the San Diego County APCD are presented as an area source in the preliminary inventory. This represents a total of 102 tons per year or 14% of the inventoried emissions. Estimates of domestic solvent use such as waxes, wax strippers, floor polishes, oven cleaners, glues, and shoe polishes have not been made, although it would appear that they may be within the same order as that of surface coating operations. Several possibilities for characterizing these emissions are currently being considered.

F. Natural Emissions--

Estimates of natural emissions from forests, agricultural activities and the human and livestock population are also difficult to make. Studies in this area are somewhat limited, however projects that will be completed prior to the end of the current program should improve these estimates.

Tables 2-8 to 2-10 present a summary of the data accumulated during Phase I of the current program that will be employed as a data base for area sources. Specific emission factors generally do not exist for these sources; however, it is the objective of current projects to estimate these rates. Rough estimates of emission rates have been made that are included in the Summary.

TABLE 2-8. ESTIMATED BREAKDOWN OF ACRES OF FOREST LANDS  
IN THE SOUTH COAST AIR BASIN

	San Bernardino	Angeles	Los Padres	Cleveland
Douglas Fir	830,000	22,000	35,000	2,000
Mixed Conifer	69,000	14,000	1,000	--
Ponderosa Pine	50,000	1,000	2,000	--
Coulter Pine	18,000	3,000	--	2,000
Pinton Juniper	22,000	12,000	21,000	--
Hardwoods	30,000	98,000	94,000	12,000
Grasslands & Brush	272,000	157,000	126,000	100,000
Barren	19,000			

KVB 5804-483

TABLE 2-9. SOUTH COAST AIR BASIN AGRICULTURAL ACREAGE ACTIVITY - 1971

Crop Production in Acres	Ventura County	Los Angeles County	Orange County	Riverside County	San Bernardino County
Tomatoes	6,690	64	3,383	37	10
Other veg. & melons	30,276	6,075	9,507	24,781	1,385
Lettuce	4,614	237	367	7,380	241
Potatoes	-	-	-	5,875	4
Seed crops	2,315	460	-	3,791	131
Barley	-	12,665	9,425	44,553	850
Wheat	-	13,840	-	20,938	280
Oats	-	-	-	2,221	1,200
Corn & silage	-	-	-	3,081	1,950
Grain sorghum	-	-	-	7,560	-
Rice	-	-	-	-	-
Safflower	-	-	-	-	-
Alfalfa	-	25,640	-	51,667	17,500
Wild & grain hay	11,564	6,540	1,123	24,593	10,600
Pasture & range	-	212,500	5,815	57,587	11,650
Cotton lint & seed	-	-	-	14,493	100
Dry beans & peas	3,880	245	1,655	1,180	77
Sugar beets	3,250	1,500	610	4,518	100
Almonds	-	1,169	-	-	-
Apples	-	24	-	6	390
Apricots	-	-	-	594	205
Citrus & avocados	49,227	4,649	14,138	41,714	17,735
Cherries	-	24	-	92	21
Grapes	-	46	-	8,434	13,517
Olives	-	35	-	67	-
Peaches	-	342	-	178	67
Plumes & prunes	-	-	-	145	66
Pears	-	284	-	2	9
Strawberries	1,273	417	1,287	-	108
Walnuts	2,243	341	-	861	80
<b>TOTAL</b>	<b>115,332</b>	<b>287,097<sup>2</sup></b>	<b>47,310</b>	<b>326,348<sup>2</sup></b>	<b>78,276<sup>2</sup></b>

GRAND TOTAL . . . 854,363<sup>1</sup> Source: County Agricultural Commissioner's Report - 1971<sup>2</sup> County totals applied to portion of county in the SCAB. Area correction will be made at a later date.

KVB 5804-483

TABLE 2-10. AGRICULTURAL WASTE PRODUCTION  
IN THE SOUTH COAST AIR BASIN AND VENTURA COUNTY<sup>1</sup>

Agricultural Wastes (Tons/Year)	County				
	Ventura	Los Angeles	Orange	Riverside	San Bernardino
Fruit & Nut Crops	107,644	-	-	139,800	87,400
Field & Row Crops	30,900	60,000	112,000	765,000	9,800
Vegetable	481,800	-	-	-	-
Manure	225,000	389,000	340,449	2,090,300	1,938,600
Total	845,344 <sup>2</sup>	449,000 <sup>3</sup>	452,449 <sup>4</sup>	2,995,100 <sup>5</sup>	2,035,800 <sup>6</sup>
GRAND TOTAL = 6,777,693					

<sup>1</sup> Totals only available for counties as a whole. SCAB area correction will be made at a later date.

<sup>2</sup> Ventura County Solid Waste Management Plan, October 1975.

<sup>3</sup> Los Angeles County Solid Waste Management Plan, October 1975.

<sup>4</sup> Orange County Solid Waste Management Master Plan, January 1974.

<sup>5</sup> Riverside County Solid Waste Management Master Plan, January 1974.

<sup>6</sup> San Bernardino County Solid Waste Management Master Plan, January 1974.



#### 2.4.6 Summary of Emissions From Other Sources

Table 2-11 presents the estimates of organic compound emissions from sources considered in this section. These estimates should be considered as preliminary and will be revised for the final inventory.

TABLE 2-11. SUMMARY OF OTHER SOURCES OF EMISSIONS

Source	Organic Compound Emissions Rate Tons/Day
Landfill Operations	120-250
Sewage Treatment	10-20
Petroleum Production	20-60
Natural Gas Transfer	25-150
Domestic Solvent Use	10-100
Natural Emissions	
Human and Animals	Negligible
Agricultural Crops	10-20
Forests	60-120
Agriculture Wastes	20-200

KVB 5804-483

## SECTION 3.0

### PHASE II TEST PLAN

A general test plan for Phase II of the current program has been developed incorporating the results of the preliminary inventory, a review of current literature and on-going programs, and discussions with numerous industrial and government representatives.

#### 3.1 FIELD TEST PROGRAM

The major objectives of the field test program will be to:

- . obtain 600 to 800 samples of organic compound emissions from 200 to 300 sources (devices) representing a cross-section of industrial activities within the Basin
- . verify the total emission rates of the major sources
- . characterize emissions and emission factors from new sources not previously inventoried
- . determine the effect of variations in device configuration and operating practices on these emissions
- . document the effectiveness of control devices.

Results of the Phase I activities clearly indicate that the laboratory analysis portion of the emissions measurement procedure will be the rate limiting factor in the field test program. In many instances, numerous samples could be obtained quickly and be justified by the value of their analytical results; however, the time and cost of analyzing these samples would be prohibitive. For example, during Phase I testing, 17 samples were obtained at one commercial spray booth to completely characterize the various aspects of the effluent exhaust and paints and primers applied. More complex industrial processes could easily justify many more samples.

It was therefore necessary to develop a test program that would meet the above objectives but remain within the scope of the current program. Two general approaches were considered. The first emphasized a

large number of test locations each with a limited number of samples. This offers the advantage of obtaining emission data from a large number of industrial plants but limits the investigation at each plant to only the largest emission sources. The second approach would limit the number of plant locations selected for testing but would allow more samples and therefore sources, process variation or control devices, to be investigated at each site. This offers the advantage of a more thorough evaluation of the emissions from smaller sources within a plant site but requires that these sites be representative of a broad class of sources. Both options would result in obtaining 600 to 800 samples from 200 to 300 sources (devices).

KVB, Inc. has selected the latter approach as the most cost effective for the current program. This is consistent with the approach used during the previous NOx and SOx assessment programs. Employing fewer test locations not only will allow a more complete evaluation of overall plant emissions, but offers the benefit of reduced coordination time with plant personnel, field test preparation periods and more time for obtaining and analyzing the test results.

Field test programs will be of two types. A major program will be conducted at selected plant locations to characterize organic compound emissions as completely as possible. These programs will require two engineers and two technicians over a two to four day period at each location, and will result in 12 to 18 samples obtained from 9 to 12 sources. Procedures for preliminary inspection, sample preparation, test and analytical procedures are described in Section 4.0. In addition, several minor programs will be conducted to broaden the data base of the program. These will generally involve a two-man test crew collecting two or four samples from a limited number of devices at one location during a one-day test program.

In determining the priorities and emphasis of the field test program, consideration was given to the following:

- . total emission rate from the source
- . availability and quality of data from other programs
- . uncertainty of emission specie profiles
- . availability of control devices

A summary of the Phase II test program is given in Table 3-1. Presented are the total emissions from each category as determined in the preliminary inventory, the number of test samples allotted for each category and the test days required for its completion. As shown, the major portion of the test program has been allocated to petroleum operations and solvent use, with lesser emphasis on the remaining categories. Organic solvent use has been given a larger share of the available test effort so that adequate characterization of the wide variety and individual nature of the industrial solvents and control devices can be made. Petroleum operation, which constitute the largest source of inventoried emissions, will receive less attention due to the fact that excellent results from several previous and ongoing studies relating to their emissions have been made available to KVB. A continuous review of the test plan will be made throughout the Phase II program and modifications are expected to best utilize the time and personnel available. A description of the tests proposed for each category is presented in the following sections.

TABLE 3-1. SUMMARY OF PROPOSED FIELD TEST PROGRAM

	Percent of Inventoried Emissions	No. Samples For Analysis	No. Days (2 Men)	No. Days (4 Men)
Petroleum	48	184	8	28
Solvent Use	42	294	28	42
Chemical	2	36	12	--
Metallurgical	--	24	3	3
Food and Agri- cultural Processing	--	33	11	--
Combustion of Fuels	3	33	6	3
Other Sources	--	33	6	3
	TOTAL	637	74	79

KVB 5804-483

### 3.2 TEST DESCRIPTIONS

The following sections briefly describe the objectives, devices, processes, and the control techniques to be investigated during the field test program. Related ongoing cooperative programs and other sources of information that will be employed during Phase II of the current programs are also presented.

#### 3.2.1 Petroleum Operations

Due to the magnitude, uncertainty and complex nature of the organic compound emissions from petroleum operations, comprehensive test programs will be conducted in several major areas.

A preliminary test program for petroleum production is presented in Table 3-2. Tests will be made at two production locations representing a high and low gravity facility. Devices to be tested will include pumping and recovery operations, gas separation, oil and water separation and storage. Tests to determine fugitive emissions from ground seepage and production operations will be of an exploratory nature due to the lack of any previous comprehensive program in this area. The primary objectives will be therefore to determine the relative magnitude and composition of emissions and provide background for further investigation in subsequent programs.

Test programs will be conducted at three petroleum refineries. Presented in Table 3-3 is a preliminary test plan for the Powerine, Douglas, and Standard Oil Refineries. KVB is currently soliciting the cooperation of these refineries. The primary objective will be to collect composition data and to ascertain the relative magnitude of various devices and compare with reported APCD emission data. Results from these tests will then be employed to estimate the emissions for the remaining refineries within the basin. A brief test program will also be conducted to estimate the emissions from asphalt and paving operations.

TABLE 3-2. SUMMARY OF PROPOSED PETROLEUM PRODUCTION FIELD TEST PROGRAM

Locations	Sources	Total No. Samples For Analysis	No. Days (4 men)
High Gravity Facility	Geogenic seepage, production venting, well head, pumps, valves, compressors, oil-gas separators, storage	25	5
Light Gravity	Well head, pumps, valves, oil-gas separators, oil-water separators, storage, effluent water disposal	25	5

TABLE 3-3. SUMMARY OF PROPOSED REFINERY FIELD TEST PROGRAM

Locations	Sources	Total No. Samples For Analysis	No. Days (4 men)
Powerine (Phase I)	FCC, treating operations effluent disposal, cooling towers, valves, pumps, compressors	24	4
Douglas	Heater, asphalt blowing, effluent disposal, blowdown systems and flares, valves, pumps, compressors, flanges, tanks, vapor recovery	46	5
Standard	Heater, FCC, skimming pond, valves, pumps, compressors, tanks, gasoline transfer	44	8

KVB 5804-483

Maximum use will be made of information being obtained from ongoing test programs related to petroleum operations. KVB, Inc. has made contact with representatives of these programs and has structured test efforts to complement them. A brief description of the program follows:

(1) A joint program with the San Diego County APCD has been proposed to investigate the efficiency and emission characteristics of several automobile tank filling control devices. Mass flow rates will be measured by the SC APCD while KVB will obtain samples to be analyzed for specie composition. In addition, the SD APCD will be an excellent source of information for costs and application data on these systems.

(2) The Western Oil and Gas Association (WOGA) is sponsoring two related programs to measure the emission characteristics from floating roof and fixed roof storage tanks. Data from these programs will be available and will be incorporated with analyses of vapor compositions collected from various storage locations.

(3) WOGA is also sponsoring an emissions program from tanker off-loading. Information from this program will be extremely valuable in estimating emissions from the proposed Sohio Long Beach Project and other terminal operations.

Several recent publications have been obtained that are directly applicable to the current program. These include a three-year program on passenger car refueling losses conducted by Scott Research Labs and a study of vapor control methods for gasoline marketing operations prepared by the Radian Corporation. Contacts have also been made with Radian concerning a three-year assessment of the environmental emissions from oil refining.

A special ambient monitoring test to be conducted by AeroVironment, Inc. in conjunction with KVB's testing at the Douglas Refinery is discussed in Section 3.4.

### 3.2.2 Solvent Use

A list of the potential test locations for industrial solvent use is presented in Appendix A. Sources have been grouped by their appropriate SIC classification as listed in the "Southern California Business Directory and

Buyer's Guide" (Ref. 3.1). This list includes sites either with total organic compound emissions in excess of 100 tons per year or are the largest production facility within that group.

One plant site will be selected for a major testing program from each of the SIC groups whose description is underlined. Selection will be made on the basis of total organic compound emissions availability, types of devices employed, and control systems in use.

Emphasis will be placed on determining the emission characteristics of the solvents under various device, process, and control situations, including the changes due to direct fired baking ovens, the use of catalysts or the selective nature of control devices. Devices whose emission characteristics can be readily determined by solvent analysis and consumption data such as degreasers and coating operations without forced drying and controls will receive less attention.

Due to the special nature of their operations, the emissions characteristics of all remaining sites listed will be tested as time permits. These tests will be conducted on a priority basis. The priority class of the proposed sources to be tested is given in Table 3.4. The priority class was assigned based on a highly subjective engineering evaluation as to the inherent value to the program of conducting tests at the particular location in question. Included in the judgment were such factors as:

1. The number of similar sources that the one source would represent.
2. The total emissions from that source.
3. The number of different devices available for testing at the one location especially the presence of emission control devices.

Several recent studies have been obtained and will be incorporated into the analysis of the Phase II test results. These include a study by Dow Chemical on solvent metal cleaning operations (Ref. 3.2), a Monsanto report on the prioritization of air pollution from industrial surface coating operations (Ref. 3.3), and an experimental study on solvent discharge from dry cleaning establishments in California by the International Fabricare Institute (Ref. 3.4).



TABLE 3-4. PROPOSED MINOR SOURCES TO BE TESTED

Plant Name	Location	Priority Class
<u>Petroleum</u>		
California Asphalt Co.	Santa Ana	I
Southern Pacific Pipeline	Bloomington	I
<u>Solvent Use</u>		
Rogers and McDonald Publishers	Los Angeles	II
Imperial Metal Finishers	Los Angeles	II
Crown Zellerbach	Commerce	I
Albert Van Luit & Co.	Los Angeles	II
U. S. Polymetric	Santa Ana	I
MICA Corporation	Culver City	II
Central Bay & Supply Co.	Los Angeles	II
AeroChem	Orange	II
Robertshaw Controls	Anaheim	II
3M Company	Camarillo	II
Islander Yachts	Irvine	II
R. E. Olds & Sons	Fullerton	II
Mattel, Inc.	Hawthorne	III
Arja Engineering		III
ITT Cannon Electric	Santa Ana	II
Northrop	Anaheim	II
<u>Chemical</u>		
Diamond Shamrock Chemical	Oxnard	II
Allied Chemical Corp.	El Segundo	II
Uniroyal, Inc.	Los Angeles	II
Allergan Pharmaceutical	Irvine	II
Max Factor	El Segundo	III
PPG Industries	Torrance	III
Fibirite	Orange	III
Inmont Corp.	Los Angeles	III
<u>Metallurgical</u>		
Soule' Steel Co.	Los Angeles	II
Trent Tube	Fullerton	II
Alcoa	Vernon	II
<u>Food and Agricultural Products</u>		
Clougherty Packing Co.	Los Angeles	III
Fillmore Piru Citrus	Fillmore	II
Hunt-Wesson Foods	Fullerton	III
Carnation Co.	Los Angeles	III
Swift Edible Oil Co.	Vernon	II
Anheuser Busch	Los Angeles	III
San Antonio Winery	Los Angeles	III
Star-Kist Foods	Terminal Island	III
Laura Scudders	Anaheim	III

Continued

TABLE 3-4 (Cont)

Plant Name	Location	Priority Class
<u>One Each Of:</u>		
Crematory		II
Photofinishing Laboratory		III
Automotive Body Shop		II
Hospital Laboratory		III
McDonald's Restaurant		III
Kentucky Fried Chicken Restaurant		III
Commercial Heater		II
Domestic Heater		II
Domestic Barbecue		III
Domestic Cooking		III

The California ARB has recently organized a Task Force on solvent emissions in the state. The test information obtained from industrial sources during the current program should greatly assist the Task Force in its efforts. A cooperative program involving architectural surface coatings has also been discussed and will be formulated in the near future.

#### 3.2.3 Chemical

Due to the relatively low level of organic compound emissions from the chemical process industries in the Basin, an abbreviated program similar to that described for minor industrial solvent users will be employed. Listed in Table A-2 of Appendix A are the SIC categories and associated industrial plants that will be considered for testing during the current program. These plants will have a priority category of II.

#### 3.2.4 Metallurgical

Sources of organic compound emissions from metallurgical operations include primary steel production and fabrication, nonferrous rolling operations, and aluminum coating. Table A-3 of Appendix A lists the major sources in the South Coast Air Basin. A major test program will be conducted at the Kaiser Steel Mill in Fontana. All other sources will have a priority class of II.

#### 3.2.5 Food and Agricultural Processing

Numerous small sources of emissions are involved in the food and agricultural processing industries. Listed in Table A-4 of Appendix A are possible test sites for each of the categories reported to have appreciable emission levels. An abbreviated test program will be conducted at each of these sites. The associated priority classes are listed in Table 3-4.

#### 3.2.6 Combustion of Fuels

Emission of organic compounds from combustion operations involve not only the products of incomplete combustion, but also the storage and handling of the fuels. The major emphasis in the current program will involve the testing of industrial and utility boilers, refinery heaters,

and CO boilers, and domestic and commercial heaters, as well as storage and transfer facilities. Tests will be conducted at one major utility boiler firing oil and natural gas, various refinery operations as described under Petroleum Operations, and several domestic and commercial heaters. A priority class of I will be assigned to these sources. Also included in this category will be the transmission losses associated with the transfer of natural gas.

### 3.2.7 Other Sources

Several other sources of organic compound emissions have been identified during the preliminary inventory. These include seepage from landfill operations, sewage treatment operations, miscellaneous agricultural activities, incineration, and from natural sources.

Major tests have been proposed at one landfill operation and one sewage treatment plant. Miscellaneous agricultural activities such as waste burning, pesticide spraying, prescribed burning, livestock wastes, and orchard heaters will have a low priority in the test program. Attempts will be made to obtain grab sample measurements of these sources. Emissions from incineration activities were shown to be negligible and will also have a low test priority.

Natural emissions from forests, plants, humans, and livestock will not be tested due to the extremely low concentrations and the complexity of their measurement. KVB is working closely with a group at Washington State University that is developing techniques for natural emission measurements.

### 3.3 PRELIMINARY TEST SCHEDULE

A preliminary schedule for the major sources are presented in Table 3-5. One major test program and up to three minor programs are tentatively planned for each week of the six month's test program. This represents the maximum attainable field program within the constraints of the program. The completion of this program will be highly dependent on receiving cooperation with plant personnel. Any reduction in the program will be made on a priority basis with the major sources listed in Table 3-4 having the highest

TABLE 3-5. PROPOSED MAJOR SOURCE TEST SCHEDULE

NOVEMBER 1976

Xerox Corporation, Pomona  
Douglas Oil Company, Paramount  
Kaiser Steel Company, Fontana  
Cooperative program with the San Diego County APCD

DECEMBER 1976

Petroleum Production Site, Ventura County  
Acme Ludlow Packaging, Temple City  
General Motors Company, South Gate  
Day and Night Manufacturing Co., La Puente

JANUARY 1977

American Appliance Company, Los Angeles  
California Rotogravure, Los Angeles  
Standard Oil Co. of California, El Segundo  
Continental Can Company, Los Angeles

FEBRUARY 1977

Lockheed, Burbank  
Petroleum Production Site, Torrance  
B. P. John Furniture Company, Tustin  
Uniroyal, Commerce

MARCH 1977

Indland Ryerson, Los Angeles  
Landfill Site, Coyote Canyon  
Southern California Edison Co.  
Reynolds Metals Company, Torrance

APRIL 1977

Robinson and Lannley, Fillmore  
Western Metal Decorating Co., El Monte  
Valley Industrial Dry Cleaners, Anaheim  
Ford Motor Company, Los Angeles

priority. A priority ranking of I to III (highest to lowest) has been tentatively assigned for each of the minor sources. Similarly, if time is available for analyzing more than the basic 600 samples planned, additional locations would be investigated.

#### 3.4 SPECIAL AMBIENT MONITORING TESTS

As originally proposed, a special program using ambient monitoring techniques will be used to characterize the emissions from a complex point source. The source selected for the first attempt at this technique is the Douglas Oil refinery in Paramount, California. This refinery was selected because it is located as far away from other major point sources of hydrocarbon emissions as any refinery in the Basin. This refinery is reasonably compact and emissions can be characterized with a fairly dense array of receptors. This ambient measurement characterization will be performed by AeroVironment, Inc., Pasadena, California, under subcontract to KVB.

While KVB is determining total refinery emissions on the basis of a source-by-source estimate, AV will make the same determination using ambient test data and plume modeling techniques. The two methods will then be compared as a check of the ambient technique. Both KVB and AV will test the refinery during the same period, November 29 to December 3, 1976. The KVB plan was discussed in Section 3.2 and the test procedures are discussed in Section 4.0. This section will summarize the AV plan.

The AV testing will be conducted between the hours of 2 AM and 8 AM on from three to five of the scheduled days. This time period was selected because a steady wind from the north is usual and because the traffic background is lowest during this period. Since refinery operations are 24 hr/day, 7 days/wk, the emissions should be representative except for storage tanks which should be at their lowest point of emissions. This will be taken into account in comparing AV's predicted emissions with KVB's data.

Figure 3-1 is the layout of sampling locations when the wind is blowing from the north. There will be one sampling location at the upwind side of the refinery, and 15 receptor points at the downwind side. Of the 15 downwind receptors, five each will be placed at each of three distances, 250 m, 700 m, and 1,000 m from the center of the refinery.

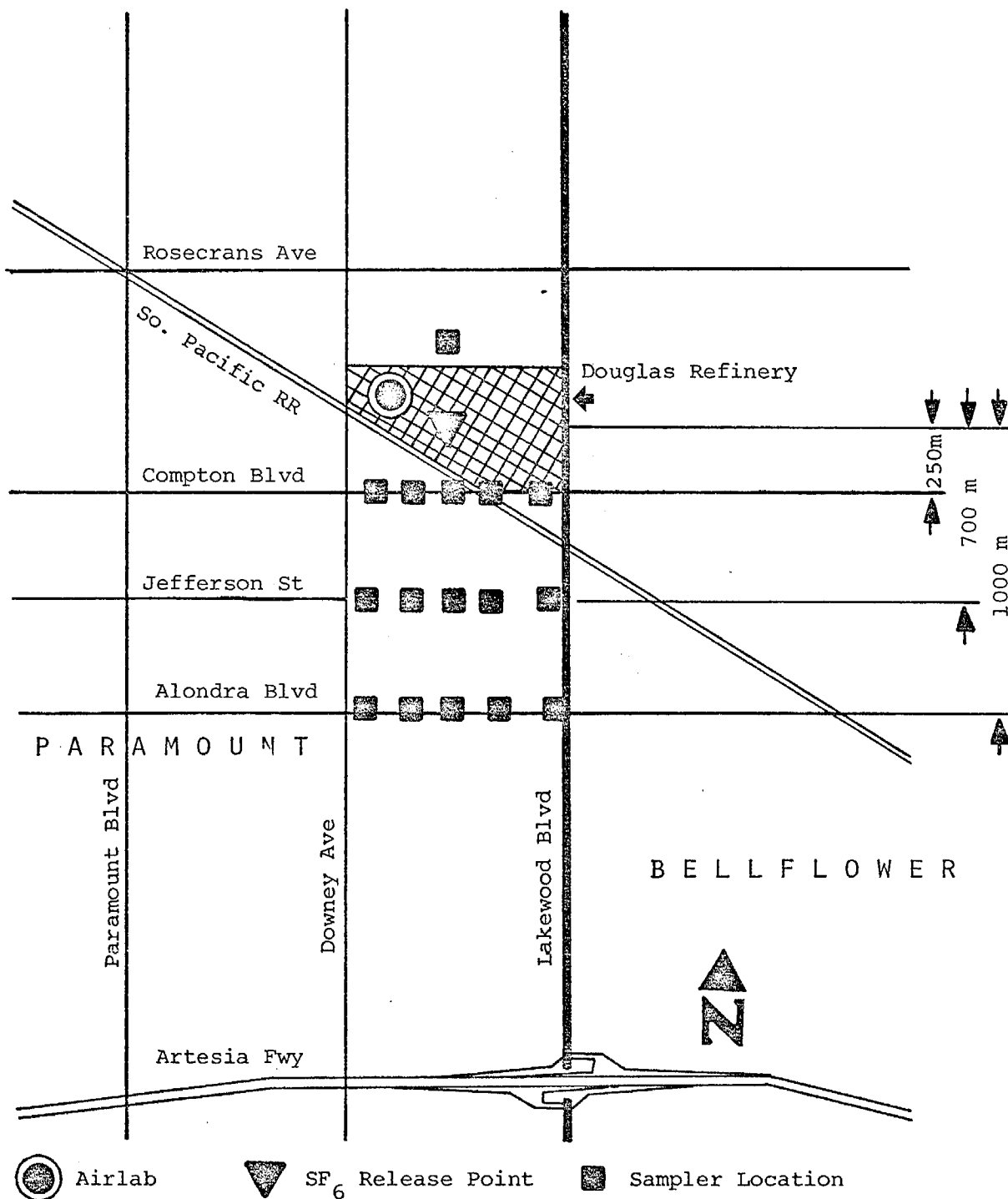


Figure 3-1. Illustration of sampling locations at Douglas refinery when wind is blowing directly from the north.

Sulfur hexafluoride ( $\text{SF}_6$ ) will be released from the center of the refinery (see Figure 3-1) one hour prior to ambient air sampling. The  $\text{SF}_6$  release rate will be approximately 1.5 kg/hr, and the release height will be 10 m.

AeroVironment's mobile laboratory (Airlab) will be stationed in the refinery (see Figure 3-1) to continuously monitor the meteorological conditions; i.e., wind speed, wind direction, ambient temperature and root-mean-square values of horizontal and vertical wind velocity components during the test period. Bag samples will be collected hourly and brought to the Airlab immediately and analyzed for total hydrocarbon (THC), methane ( $\text{CH}_4$ ), and carbon monoxide (CO) concentrations. These same bag samples will be subsequently analyzed for  $\text{SF}_6$  content.

In addition to the bag samples collected for the Airlab on-site analyses, a bag sampler and a charcoal adsorption cartridge will be located at the upwind location and two of the downwind receptor points for the hydrocarbon speciation tests. Those samples will be sent to the Analytical Research Laboratories, Inc. (ARLI) at the end of each test day for GC-MS analyses.

A mechanical weather station will be installed in the refinery on November 12 in order to gather meteorological information for the area. The Airlab is scheduled to be positioned at the refinery on the morning of November 22 and stationed there for the entire test period.

For operations to commence on November 29, a preliminary weather outlook will be obtained at 6:00 PM on Sunday, November 28. Subsequent forecasts will be obtained daily at noon until testing is completed. The final decision on whether tests will be conducted on any given day will be made by the AV Test Coordinator.

Following is the daily schedule for each test day; however, actual details may be changed as required:

0200  $\text{SF}_6$  release from center of Douglas Refinery  
Beckman hydrocarbon analyzer calibration  
 $\text{SF}_6$  monitor calibration  
Field operators deployed to assigned receptor points



0300 Begin first ambient samples set collection  
0400 End of first ambient samples set collection  
Begin second ambient samples set collection  
0500 End of second ambient samples set collection  
Begin third ambient samples set collection  
0600 End of third samples set collection  
Begin fourth ambient samples set collection  
0700 End of fourth ambient samples set collection  
SF<sub>6</sub> release shut-off

All samples collected will be immediately brought to the Airlab for THC/CH<sub>4</sub>/CO analysis, and the subsequent SF<sub>6</sub> analyses. Samples for the GC-MS analyses will be sent to ARLI at the end of each test day.

### 3.5 QUESTIONNAIRES

In addition to the above-described field test program, questionnaires will be mailed to all sources within the Basin with reported total organic compound emissions in excess of ten tons per year. The objectives of this questionnaire are as follows:

- . obtain an updated listing of the number and types of equipment and control devices currently in operation
- . details of the types and quantities of solvents used in degreasing, surface coating, and dry cleaning operations
- . assist in selecting representative test locations within an industrial classification
- . general information on plans for future modification of operating practices, equipment purchases, or general plant expansion.

Maximum use of APCD data files and recent questionnaires will be used to limit this effort.

Individual questionnaires directed to a specific industrial category have been prepared and are presented in Appendix B. These include petroleum production, petroleum refining, industrial surface coating, dry cleaning, degreasing, and general solvent use. Results from previous inventories of industrial fuel consumption obtained during the ARB-sponsored NOx and SOx studies are believed to be adequate for the current study as the organic compound emissions from these sources is relatively minor and should not change appreciably over a two to three-year period. Consumption of fuel by the electrical utilities will be updated to 1975 to reflect the increased use of fuel oil.

The information obtained from the questionnaires will be extremely valuable in correlating the data from the field test program with sources not actually tested. For example, details on the types and quantities of solvents used, the application and drying procedures, and the type and condition of control equipment are required prior to estimating emissions from surface coating operations.

## SECTION 4.0

### SAMPLING AND ANALYSIS METHODOLOGY

Sampling and analysis methodology described in this section was developed during the Phase I period of the program. The objectives were to develop techniques and equipment as necessary to (1) determine the hydrocarbon emission rate from both ducted and fugitive sources (2) collect and preserve representative samples of these emissions and (3) analyze the samples for their organic chemical composition. The general approach to emission rate determination will be to either measure the emission rate or to determine it by calculations from process data or by experiment. From ducted sources, such as stacks, emissions will be determined by conventional velocity determinations. Where information is available on the amount of product lost from a process, this will be used to determine emissions. Where the emissions are due to leaks or spills or other types of fugitive emissions, then some attempt will be made to either measure or estimate those emissions. In some instances, special experiments will be conducted to obtain estimates of emission rates. An example of the type of experiment that will be conducted involves the determination of the amount of solvent which is emitted from an architectural coating as it dries or cures. Investigation in this area has revealed that in some instances as much as 30 or 40 percent of the solvent is actually retained in the paint after it is cured, and is not emitted.

For analytical purposes, samples of emission gases will be collected in any or all of the following type of containers:

1. tubes filled with activated charcoal
2. borosilicate glass bottles
3. Tedlar bags
4. glass bulb containing 1% sodium bisulphite solution (aldehyde determinations).

The charcoal sorbent tubes will be used to collect organic compounds with carbon numbers of six or greater. The gas collection jars and bags will be used to collect compounds with carbon numbers less than six. On most major sources, a combination of sorbent tubes and either bags or bottles will be used.

All samples will be analyzed using gas chromatography (GC) and mass spectrometry (MS) techniques on a tandem GC/MS apparatus. The bottle or bag grab samples will be introduced directly into the apparatus while the samples collected on charcoal will be first extracted with carbon disulfide. Because of the survey nature of the program only those GC peaks which contribute at least 1% of the total hydrocarbons will be identified unless a substance of special importance is suspected to exist in the sample.

Presented in the following sections are a detailed description of the field test and laboratory equipment, some explanation for their selection, the results of some tests run during the Phase I program using this equipment, and a detailed description of test procedures and data reduction techniques to be followed during the program.

#### 4.1 EQUIPMENT

##### 4.1.1 Description

##### A. Sampling Train--

KVB designed and built two identical portable sampling units with the following capabilities:

1. measure stack temperature and velocity
2. filter out particulates larger than 2 microns
3. collect samples in sorbent tubes, glass jars or polybags.

Figure 4-1 illustrates the assembled sampling trains. Materials of construction are as follows:

- . all metal components are stainless steel
- . seals are Viton or Teflon
- . containers are borosilica glass
- . flexible connections are latex rubber.

KVB

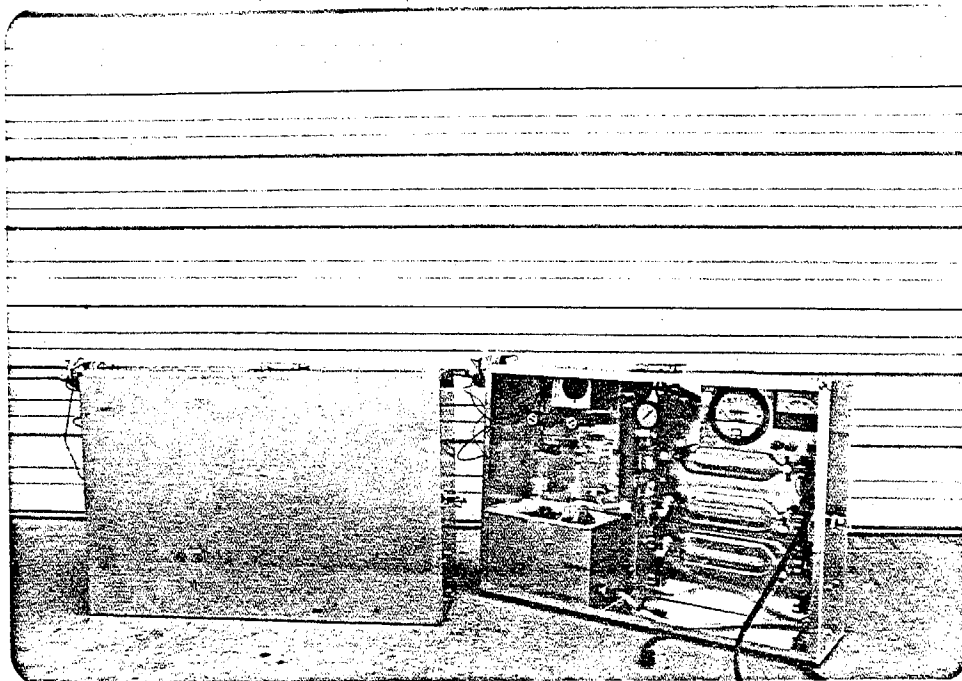
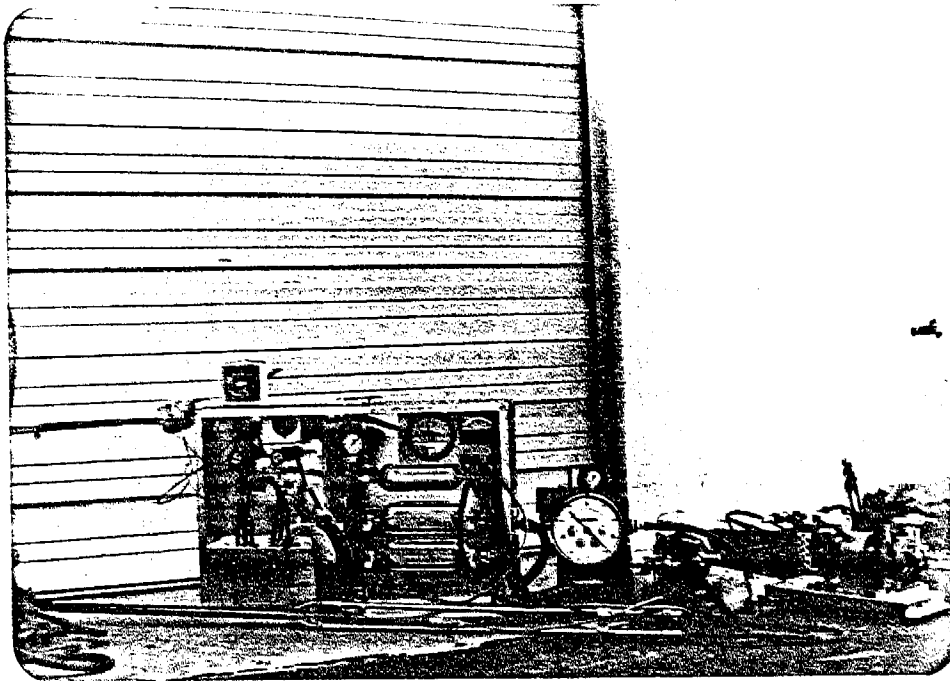


Figure 4-1. KVB Hydrocarbon Sampling Trains.

KVB 5804-483

The general flow diagram illustrated in Figure 4-2 illustrates all components of the assembly which are available to be switched into several sampling modes to conform to requirements dictated by the source to be tested. The components are:

1. a sample nozzle
2. a filter holder with 2.5 micron pore size glass fiber filter
3. a filter and line heater and thermostatic control
4. an impinger train containing LiOH crystals
5. aborosilicate (Pyrex) gas collection bottle
6. a sorbent tube train with thermometer and vacuum gauge
7. a Brooks flowmeter with needle valve flow control
8. various interior and exterior valves and connectors as indicated in Figure 4-2
9. a meter connection to PD gas meter
10. a Magnehelic velocity gauge and pyrometer for use with a pitot tube

The above system is unitized within a portable aluminum closure. Its interior arrangement permits significant freedom of directional orientation for rigging convenience dictated by sample station limitations. In addition to the packaged sampling unit, the following additional test equipment will be used:

1. two pitot tubes for velocity measurements
2. two thermocouples for stack temperature measurements
3. three dry gas meters capable of measuring 0.01 cu. ft. of gas
4. additional glass sorbent tubes containing charcoal adsorbent
5. two Gast vacuum pumps
6. six Spectrex diaphragm pumps
7. two squeeze bulb type hand pumps
8. an Orsat analyzer for CO, CO<sub>2</sub>, O<sub>2</sub>, and N<sub>2</sub> determination
9. a Draeger gas detector with detector tubes
10. a TLV sniffer with recorder (a total hydrocarbon tester with 0-10,000, 0-1,000 and 0-100 ppm range)
11. an anemometer
12. thermometers of various ranges
13. liquid sampling equipment, graduated cylinders, and funnels
14. rigging tools and two test transportation
15. two VW micro buses as support vehicles

Typical test setup and configurations are discussed in Section 4.2.1.

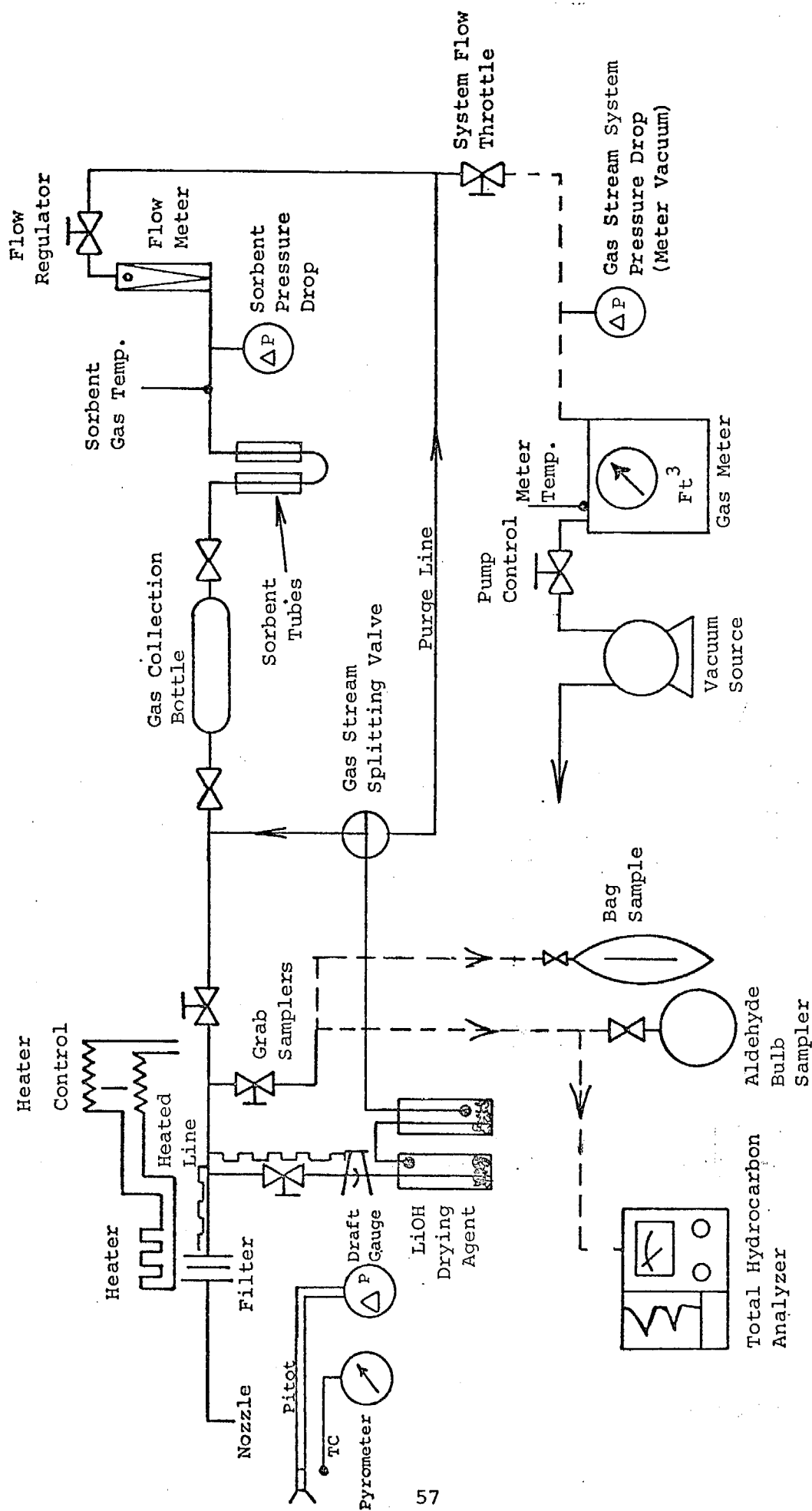


Figure 4-2. Complete hydrocarbon sampling train as set up for a hot combustion source (> 180°F) (Model in Table 4-5).

KVB 5804-483

B. Analytical Equipment--

KVB's subcontract laboratory, Analytical Research Laboratory (ARLI) will use one or both of the two GC instruments it has modified to furnish gas-loop capability. The tandem GC/MS system used at ARLI consists of the F&M Model 5756 GC, and/or alternately the Beckman GC Model 55 and CEC 21-104 mass spectrometer. When operated in tandem, the GC column effluent is split into two streams, 50% going to the FID, and 50% to the MS. The MS input (GC effluent) is concentrated more than twenty fold by a Finnigan Jet Separator. Cracking patterns are obtained by the high scan-speed MS for GC peaks of interest. Following constituent identification, quantification can then be achieved using standard GC calibration techniques. Analytical information thus obtained is then entered into the computer file for future reference.

Because of traffic pressure on the computer-integrator, data storage prior to integration is required. ARLI does this with an in-house designed and fabricated system. Signals to the GC recorders are tapped and converted from analog to audio frequency, which are recorded on one of four available magnetic tape channels. When called, these records are played back at 4X speed through f/a converters and into the computer-integrator for reduction. Reproducibility of this system has been carefully evaluated and has been found to be essentially distortion-free.

In mass spectrometry operations, ARLI maintains its own spectral catalog in addition to using published data and commercial computer MS data files. The catalog is computer assembled and contains considerable pertinent information. The accumulated sum of spectral data from trace analysis programs is contained in the catalog. The spectral data from the catalog is used directly in a program which computes the combinations of patterns that most nearly reproduce observed sample spectra. It should be noted, however, that computer programming of mass spectrometer data is used to complement but not replace the manual calculations and interpretations.



The commercial computerized MS pattern searching system that would be used by ARLI on the present program is that offered by Cyphernetics, Inc. This system contains over 49,000 cracking patterns, including many input by the EPA.

ARLI's CEC 21-104 instrument was designed particularly to fulfill the analytical needs for compound identification, structure elucidation, and molecular weight determination. This instrument has a full mass range of 1 to 2000 with a resolution of  $> 4500$  ( $17^\circ$  contribution definition). Both magnetic and electrical scanning are available at speeds of up to 1 sec. per decade. Three sample inlets operated in parallel are used for continuous monitoring, and to analyze volatile solids, liquids, and gases. Sensitivity is better than 1 ppm, depending on operating conditions and mixtures being analyzed.

The 21-104 instrument is equipped with the following

1. Electron Multiplier/Ion Filter ( $> 10^6$  gain).
2. Direct Sample Introduction System - A temperature-programmed probe (to 35 C) is used to introduce solid samples directly into the ion source. Identifiable spectra can be obtained on less than 1 microgram of sample.
3. Total Ionization Measurement System - Used for detection of GC effluent or instrument calibration.
4. High Speed Oscillographic Recording - (Type 5-124).

#### 4.1.2 Basis for Selection

##### A. Sampling Train--

1. LiOH Impinger--The lithium hydroxide in the dry impinger train was selected for use based on experience gained on the Apollo space capsule. Initially an ice water impinger was considered for moisture, NOx, SOx, and CO removal. The problem with this approach was that it was felt that the alcohols and some other oxygenates would form azeotropes with water and would not be easily separated for analysis. (The impinger solution would be analyzed for hydrocarbons.) LiOH was used in the Apollo life support system to

absorb primarily CO. In the sampling time it also neutralizes NOx and SOx which would react with the hydrocarbons. Also the LiOH is hygroscopic and will absorb most of the condensed moisture. Furthermore the LiOH should not adsorb hydrocarbons according to Apollo data. A CS<sub>2</sub> extraction and a hydrocarbon analysis will be made on the impinger contents even though it is expected that negligible hydrocarbons will be found.

The probe, filter, line and valves leading to the impinger will be maintained at > 220°F. Moisture condensation will begin in the impinger but the amount will be limited because the impinger will be at ambient temperature. Some light condensation is expected downstream of the impinger in the collection bottles and sorbent tubes but this is not expected to interfere with the hydrocarbon determinations. A separate water knockout train will be used to measure the water content of the exhaust gas.

KVB will continue to evaluate the use of LiOH during the field test program. These are a comparatively small number of combustion sources planned so that this decision will not have a major impact on the total results.

2. Sorbent-- The suitability of several different types of sorbent materials was investigated. The materials tested included: Tenax GC, Carbosieve B, activated charcoal, and XAD-2 resin. The criteria observed in the selection of the sorbent include quantitative retention and recoverability of every analyte possible. These qualities are dimensionalized by measurement of breakthrough volumes and recovery efficiencies. Table 4-1 presents the breakthrough volumes of the sorbents (25 °C) for hexane and benzene. These analytes are considered to represent about the upper limit of materials that can be analyzed in gas grab samples. Carbosieve B and activated charcoal show particularly high retention capacities.

Another important parameter in sorbent selection is the analyte recovery efficiency. High temperature, thermal stripping, with a purge gas or in vacuo, of adsorbed components on Tenax, Carbosieve B and XAD-2 was

TABLE 4-1. RETENTION EFFICIENCIES OF VARIOUS SORBENTS

	Breakthrough Volumes,* l/g sorbent	
	Benzene	Hexane
Carbosieve B	47	65
Tenax GC	3	4.4
XAD-2 Resin	12	20
Activated Charcoal	30	43

\*Measured as the volume of gas/grams of sorbent in cartridge to give a 0.1% FID response to gas stream containing 50 ppm of test component.

KVB 5804-483

considered but later rejected because the entire sample must be committed in a single determination. Recovery efficiencies using the thermal/purge-gas techniques also showed high molecular weight discrimination (see Table 4-2).

Solvent stripping for analyte elution preparatory to chromatographic analysis was investigated. Carbon disulfide was found to be an attractive solvent not only because of its excellent solvent properties, but because of its zero FID response. Many of the other common solvents, such as methylene chloride, chloroform, hexane, benzene, etc., tend to swamp the chromatogram, obliterating any signals of components that have boiling points even decades higher.

Unfortunately, it was found that Tenax GC is soluble in  $\text{CS}_2$  as well as in  $\text{CH}_2\text{Cl}_2$ . Carbosieve B showed poor recoveries with solvents. Testing was therefore primarily focused on solvent extraction of activated charcoal with  $\text{CS}_2$  and XAD-2 resin extraction with  $\text{CH}_2\text{Cl}_2$  ( $\text{CS}_2$  also dissolved XAD-2). Table 4-3 presents the results. Mueller and co-workers (Ref. 4.1) have reported similar efficiencies for halogenated and oxygenated hydrocarbons using charcoal adsorption followed by  $\text{CS}_2$  elution. Based on the data they presented and the precedent set by the National Institute for Occupational Safety and Health (NIOSH) in the selection and published (Refs. 4.1-4.4) characterization of the charcoal/ $\text{CS}_2$  analysis scheme, the use of coconut-derived activated charcoal as supplied by Mine Safety Appliances or SKC, Inc. was selected as the material of choice for source sampling.

TABLE 4-2. RECOVERY EFFICIENCY OF PURGE-THERMAL  
STRIPPING OF SELECTED ANALYTES

	TENAX	Carbosieve B	XAD-2
	% Recovery	% Recovery	% Recovery
Benzene	105	--	--
n-C <sub>7</sub> H <sub>16</sub>	100	11	--
n-C <sub>8</sub> H <sub>18</sub>	99	<1	--
n-C <sub>9</sub> H <sub>20</sub>	94	<1	--
n-C <sub>10</sub> H <sub>22</sub>	72	<1	62
n-C <sub>11</sub> H <sub>24</sub>	67	<1	60
n-C <sub>12</sub> H <sub>26</sub>	67	<1	--
n-C <sub>13</sub> H <sub>28</sub>	58	<1	--
n-C <sub>14</sub> H <sub>30</sub>	56	<1	--
n-C <sub>15</sub> H <sub>32</sub>	61	<1	--
n-C <sub>17</sub> H <sub>34</sub>	46	<1	--

TABLE 4-3. SORBENT RECOVERY EFFICIENCIES FOR NORMAL  
ALKANES USING SOLVENT ELUTION TECHNIQUES

n-Alkane	Activated Charcoal/CS <sub>2</sub>	Carbosieve B/CS <sub>2</sub>	XAD-2 Resin/ CH <sub>2</sub> Cl <sub>2</sub>
n-C <sub>6</sub>	97	<1.0	Solvent Masked
n-C <sub>7</sub>	98	<1.0	Solvent Masked
n-C <sub>8</sub>	92	<1.0	Solvent Masked
n-C <sub>9</sub>	87	<1.0	Solvent Masked
n-C <sub>10</sub>	90	<1.0	100+
n-C <sub>11</sub>	90	<1.0	97
n-C <sub>12</sub>	90	<1.0	--
n-C <sub>13</sub>	100+	<1.0	--
n-C <sub>14</sub>	76	<1.0	--

## B. TLV Sniffer

The Bacharach TLV sniffer was selected for use on this program to provide a preliminary estimate of total hydrocarbon emissions to provide an indication of variations in hydrocarbon concentrations in the exhaust gas due to process changes and to assist in the quantifying of fugitive emissions. It can also serve as some check on the results attained by GC/MS analysis of fuel samples. This device was selected because compared to other total hydrocarbon measuring devices it was smaller, lighter in weight, fast responding and less expensive. The price is under \$1,000. Other devices of total H/C measuring capabilities cost \$3,000 or more. Of course these other instruments are more versatile and possibly more accurate. Also it is explosion-proof (FM approved) whereas some of the more expensive units are not.

The TLV sniffer is an improved version of a lower-explosive-limit (LEL) detector of combustible organics with an improved sensor and an accuracy greater than the conventional LEL type instruments. It detects hydrocarbon emissions and quantitatively records them in ppm as hexane; however, this read-out can be converted to any specific hydrocarbon or LEL limit readings. Because it is FM approved, it can be used in refineries or other locations where potential explosive mixtures exist. It incorporates a contact mass sensor with resistance to catalytic poisonings; an explosion proof potentiometric recorder output, automatic voltage regulation, meter display, sampling pump and a rechargeable battery power source. The system uses the heat of combustion of the gas-in-air mixture as hydrocarbon sensing. A relative response curve supplied with the instrument permits quantitative measurement of some individual gas species.

Table 4-4 illustrates the conversion factors for converting meter readings of hexane to other gases.

Figure 4-3 illustrates the conversion factors of ppm readings to LEL equivalents.

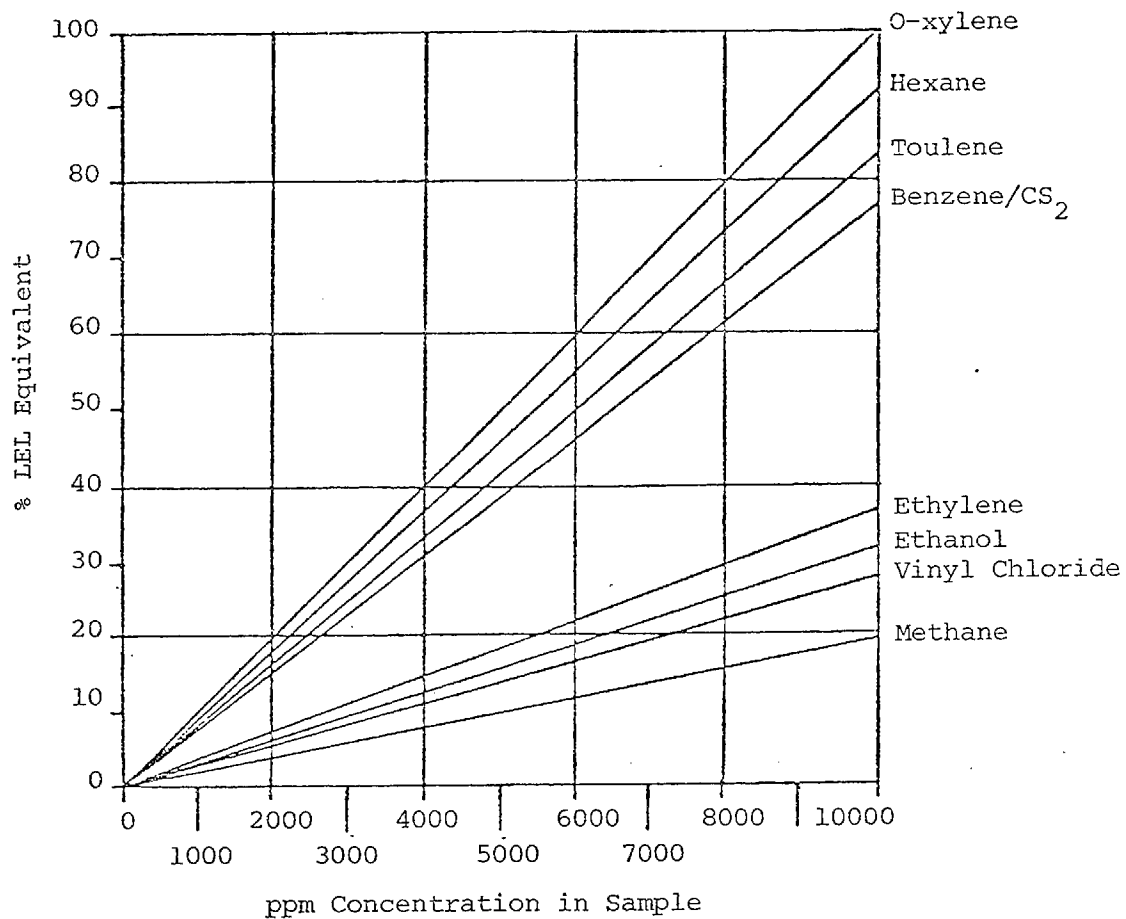


Figure 4-3. TLV sniffer: conversion curves showing relationship of ppm concentrations of various gases to percent LEL equivalents.

KVB 5804-483

TABLE 4-4. MULTIPLYING FACTORS FOR CONVERTING ppm METER READINGS OF HEXANE-CALIBRATED INSTRUMENTS TO ppm CONCENTRATIONS OF OTHER GASES ON TLV SNIFFER

Gas Detected	Factor	Gas Detected	Factor
Acetone	1.50	Methane	1.58
Acetylene	1.78	Methanol	3.71
Benzene	1.02	Methyl Acrylate	3.37
1,3 Butadiene	1.52	Methyl Chloride	3.81
Butyl Acetate	2.08	Methyl Chloroform	4.44
Carbon Disulfide	5.92	Pentane	1.04
Cyclo Hexane	1.02	Perchloroethylene	13.66
Ethyl Acetate	2.22	Propane	1.14
Ethylene Oxide	2.05	Styrene	2.25
Heptane	1.05	Toluene	1.03
Hexane	1.00	Trichloroethylene	6.40
Hydrogen	1.45	Vinyl Chloride	2.24
M.E.K.	1.60	Xylene (O)	1.64

KVB 5804-483

## 4.2 PROCEDURES

### 4.2.1 Field Testing and Sampling

To prepare the testing and sampling of a source, plant visits and on-site inspection of the source will be made after direct contact with and approval by personnel from plant management, operations and safety engineering. When possible, the following preparatory information will be obtained:

- . plant size and location
- . process parameters: type, temperature, process mass flow
- . plant safety requirements
- . sampling facility and accessibility

This information will be used by KVB's field test engineers to prepare equipment and recording forms and analytical support. A definite test date will be scheduled in coordination with the management of the plant or source to be tested.

#### A. Train Selection--

The specific sampling train configuration to be used on a particular source depends on the following factors:

1. the classes of organic compounds expected in the emissions
2. the temperature of the emissions
3. the water content of the emissions
4. the type of emission flow (i.e., ducted or fugitive)

Table 4-5 indicates the sampling equipment to be used for 17 different source types. For each ducted source the universal sampling train presented earlier in Section 4.1.1.A will be adapted as indicated in Table 4-5 by the "mode" numbers one through three. Figures 4-2, 4-4, and 4-5 show the first three of these different adaption modes. Modes four and five involve the measurement of fugitive emissions. Figures 4-6 through 4-9 illustrate the sampling setups for a typical fugitive source, in this case a petroleum transfer line valve. In Figures 4-6 and 4-7 the setups for a cold valve are shown for two different leak rates while in Figures 4-8 and 4-9 the setups for a hot valve ( $T > 160^{\circ}\text{F}$ ) are shown.

Figure 4-2 illustrates the train setup for high temperature combustion source sampling. The train filters out particulates at stack temperature, collects aldehydes, collects moisture,  $\text{NO}_x$ ,  $\text{SO}_x$  and CO on LiOH in two impingers, and collects hydrocarbons by entrapment in a bottle and by adsorption in sorbent tubes.

Figure 4-4 illustrates the sample train as used sampling high and low temperature sources with insignificant water vapor content. The train filters out particles, collects aldehydes, and collects hydrocarbons by entrapment and by adsorption. It records fluctuation in total hydrocarbon emissions using the TLV sniffer.

Figure 4-5 shows the configuration used in sampling cold solvent sources such as dry cleaning, degreasing and painting processes. The train filters particulates, monitors total hydrocarbon emissions fluctuations, and entraps hydrocarbons in gas collection bottles.



TABLE 4-5. TEST AND SAMPLING TRAIN CONFIGURATIONS BY SOURCE TYPES

Sampling Train Components	SOURCE TYPE																											
	Refinery Combustion	Fuel Combustion	Combustion	Waste Disposal and Burning	Coking Operation	Catalytic Burners	Metal (Smelting) Production	Heat Treated Surface Coating	Air Dried Surface Coating	Printing Surface Coating	Operations	Rubber, Adhesive Production	Hydrocarbon Storage	Degreasing, Stripping	Paint Shops	Dry Cleaning	Oil Field Production	Oil, Solvent Transfer, Cold	Oil, Solvent Transfer, Hot									
Filter and Lines Heated	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X									
Filter and Lines Unheated																												
Draeger Gas Indicator	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X									
Total Hydrocarbon Instr.																												
Orsat Analyzer	X	X	X	X	X	X	X																					
Aldehyde Bulbs	X	X	X	X	X	X	X	X																				
Impinger, LiOH	X	X	X	X	X	X	X	X																				
Sorbent Tubes	X	X	X	X	X	X	X	X	X	X	X	X	X															
Gas Collection Bottle	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X									
Bags, Metered Flow						X							X				X	X										
Bags, Rapid Fill	X			X								X																
Minimum Sample Nos.	5	4	4	5	4	2x5	4	3	2	3	3	3	3	2	1	1	1	2	1									
Velocity Measurement	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X		X										
Meter	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X										
Gas Pump	X	X	X	X	X	X	X	X	X	X	X	X																
Pyrometer (Source T)	X	X	X	X	X	X	X																					
Thermometer (Source T)								X	X	X	X	X	X	X	X	X		X	X									
Psychrometer								X	X	X	X	X	X	X	X	X												
Hand or Small Pump									X	X			X	X	X	X	X	X	X									
Mode	1	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	4	4	5									
Type No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	17									

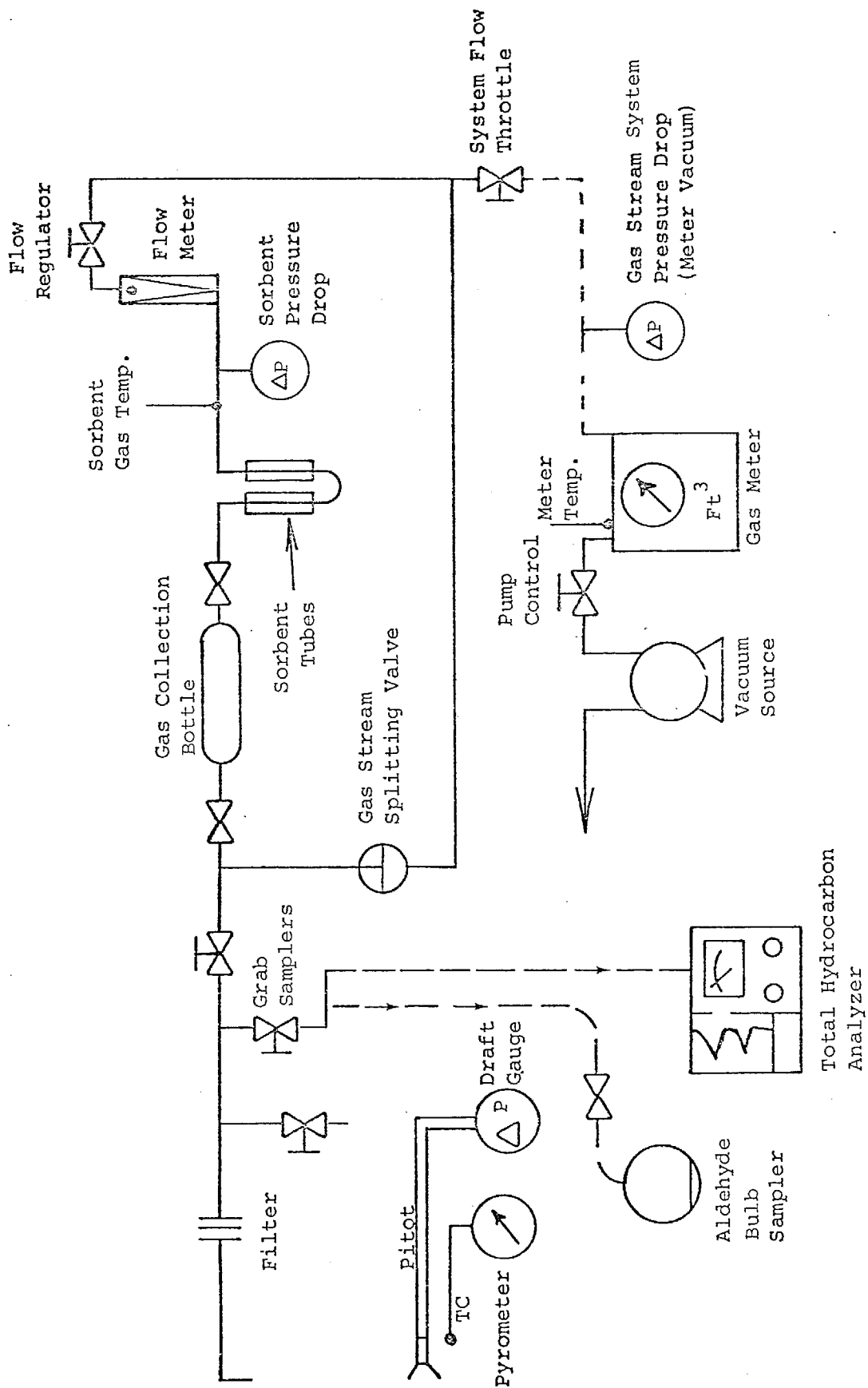


Figure 4.4. Hydrocarbon sampling train configuration for continuous solvent process related sources of high complexity (Mode 2, Table 4-5).

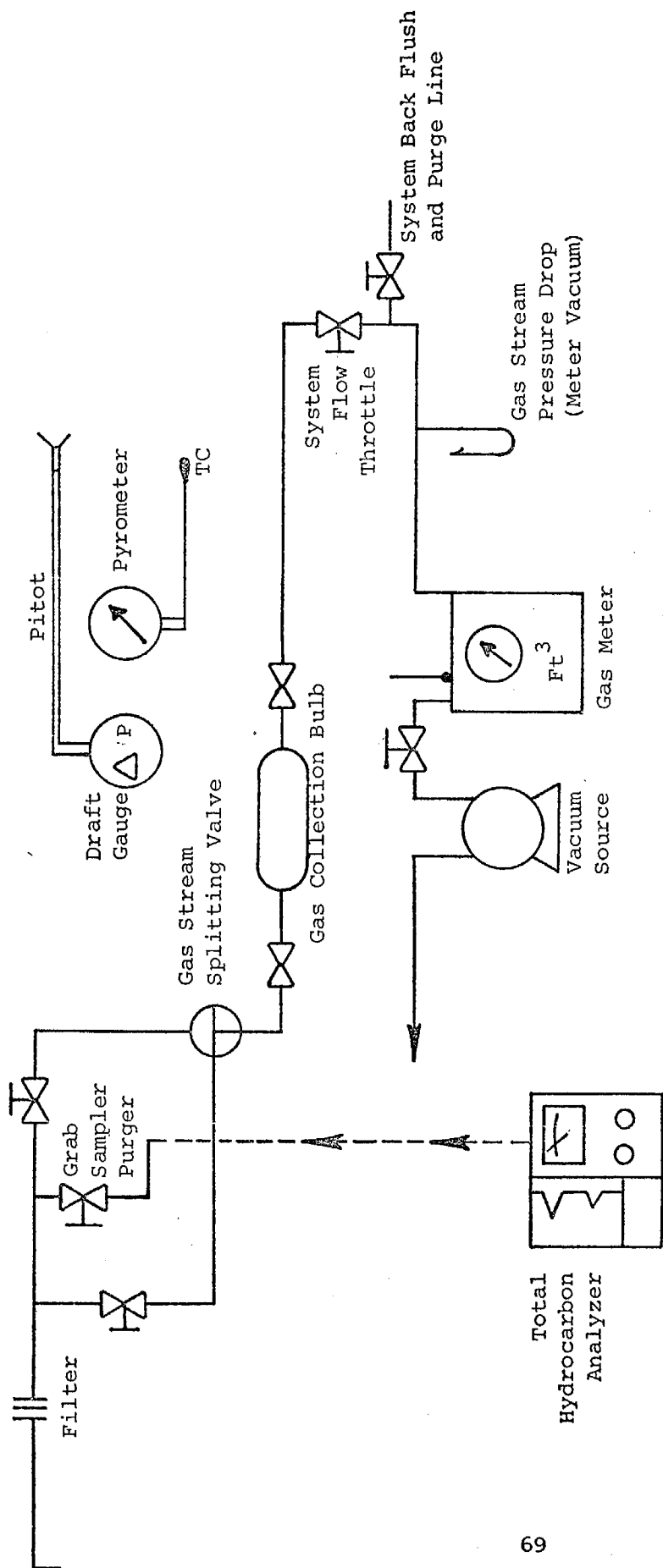


Figure 4.5. Hydrocarbon sampling train configuration for solvent operations in batch operations (Mode 3, Table 4-5).

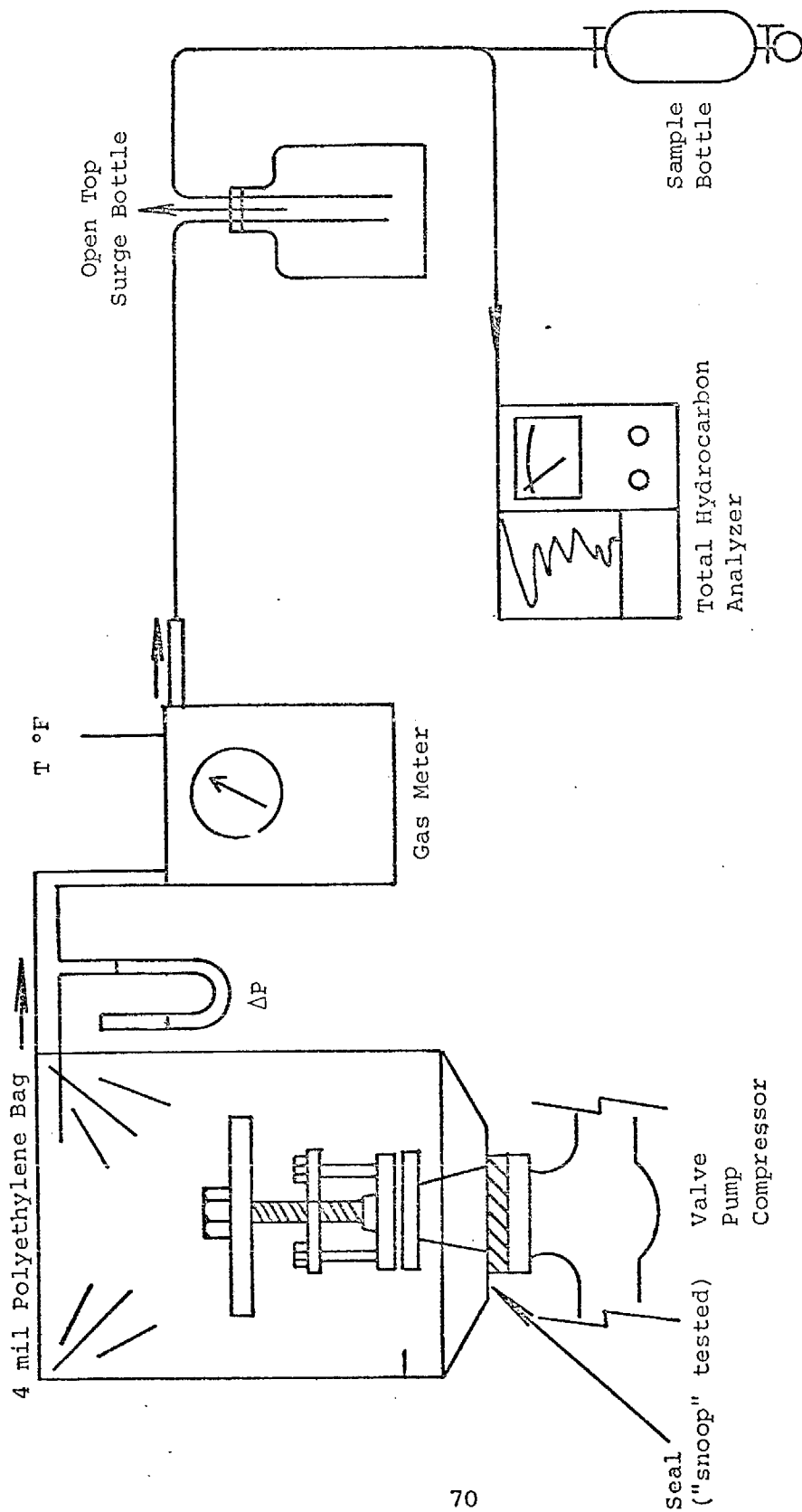


Figure 4.6. Leak rate and concentration measurement of ambient temperature fittings. High leak rates. (Mode 4, Table 4-5)

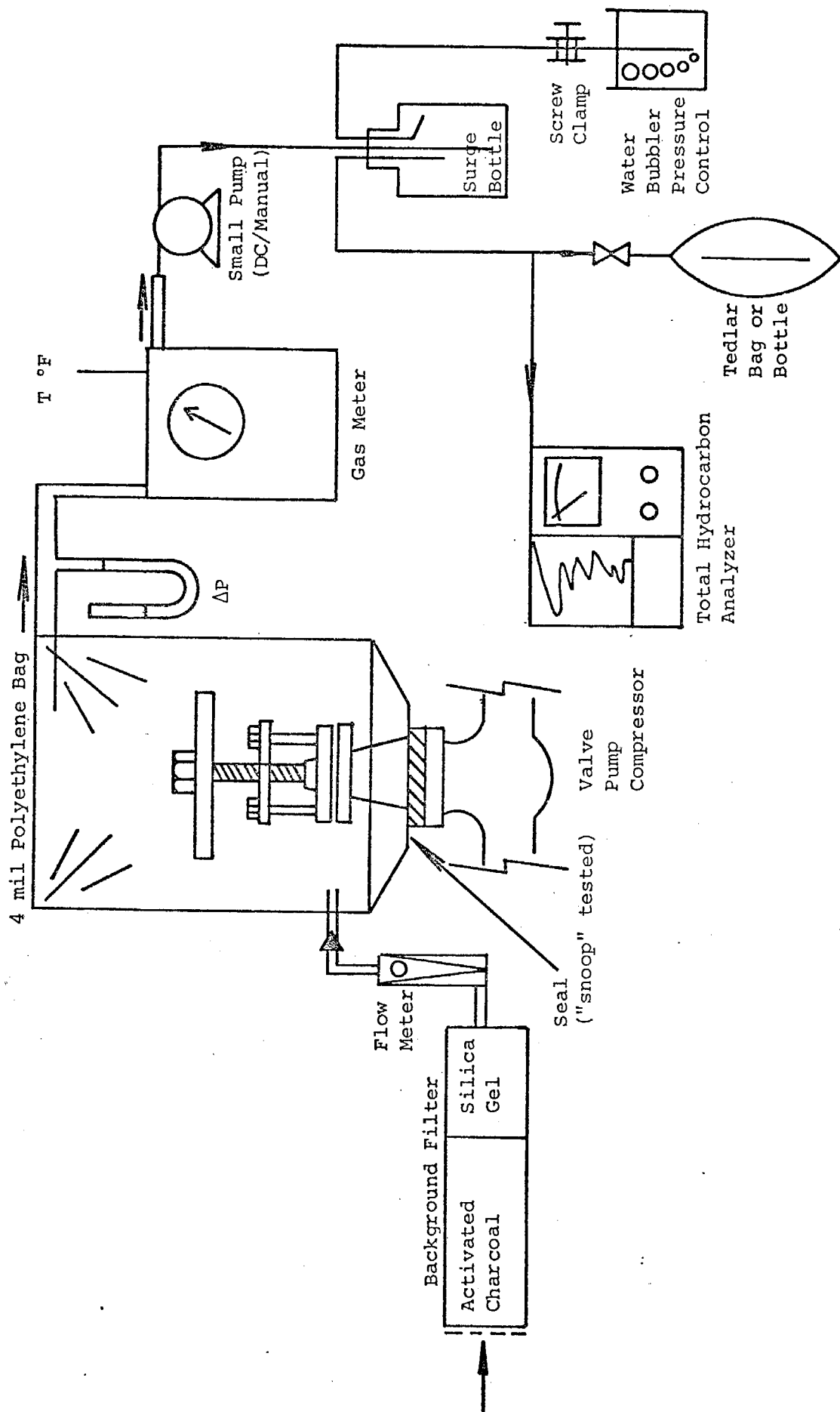


Figure 4.7. Leak rate by dilution sweep and sampling of ambient hydrocarbon fitting.  
Low leak rates. (Mode 4, Table 4-5)

5804-483

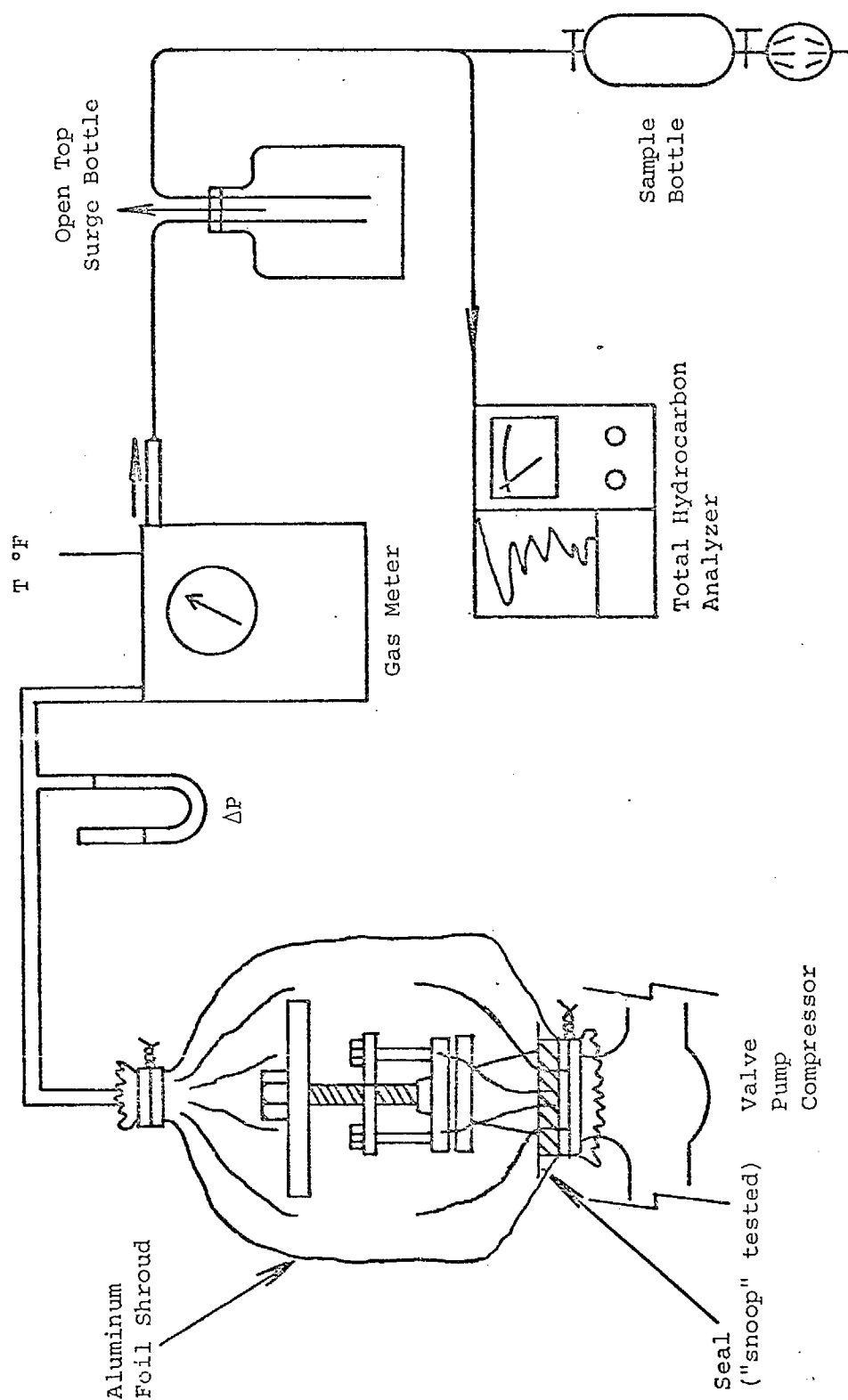


Figure 4.8. Leak rate measurement and concentration measurement of high temperature fitting.

5804-483

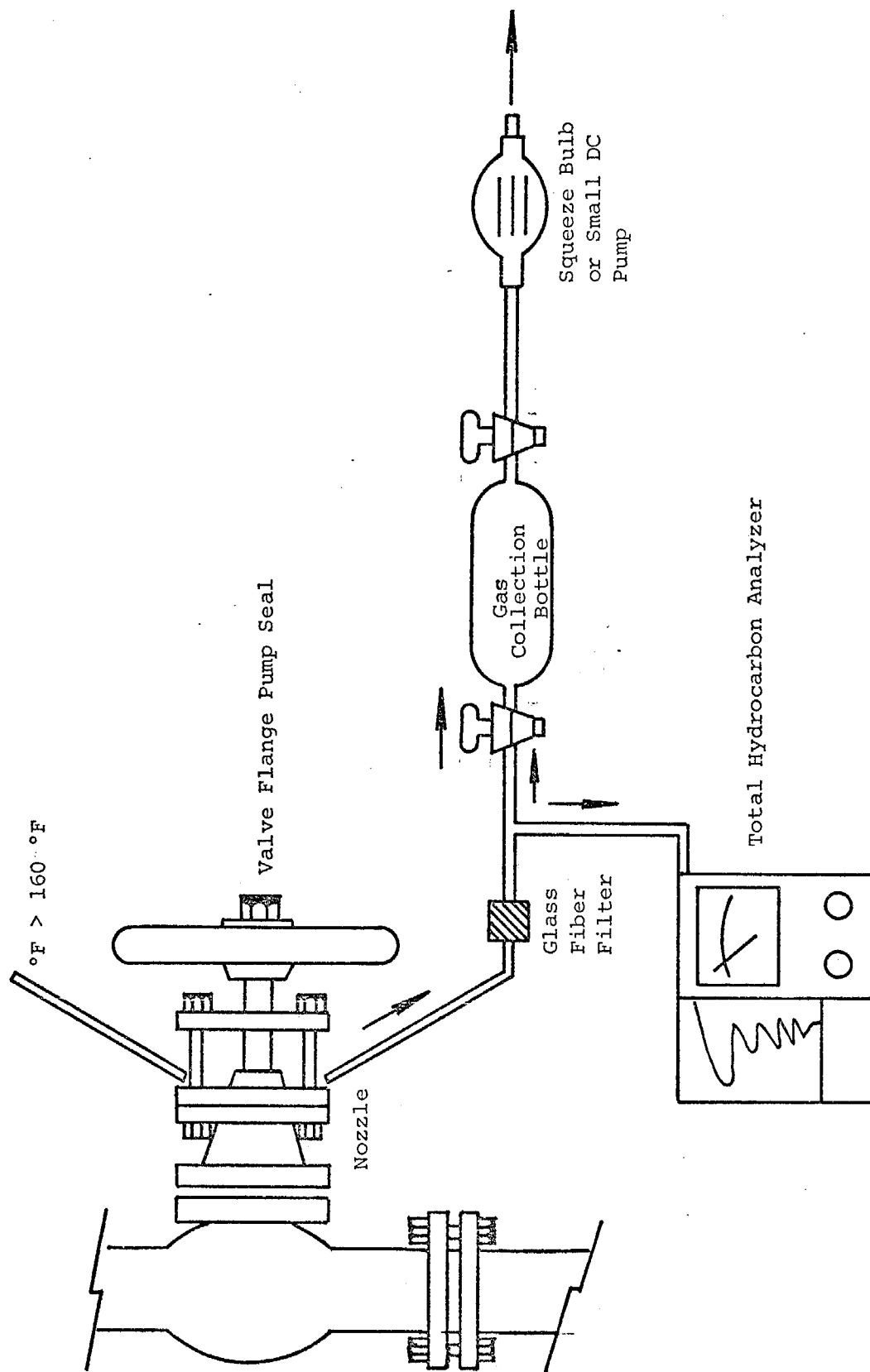


Figure 4.9. Hydrocarbon sampling from hot oil or solvent transfer (Mode 5, Table 4-5).

Figures 4-6 and 4-7 illustrates sampling setup for testing ambient fugitive emission sources. It measures the rate of emission, monitors total hydrocarbon concentrations, and collects gaseous emissions for analysis. In the first case the H/C leak rate is so great that the vapors fill the tent and drive the gas meter. In the second case a pump is used to draw purified air through the tent to pick up the emitted H/C vapors.

Figures 4-8 and 4-9 illustrates test setup for sampling a high temperature fugitive emission source. In Figure 4-8 aluminum foil is substituted for polyfilm and rates are measured as Figure 4-6 or 4-7. When the foil cannot be used the setup in Figure 4-9 is used. The temperature of the source is measured, a grab sample is obtained in a gas collection bottle, and the concentration of total hydrocarbons is measured. The leak rate is obtained by applying engineering judgments.

#### B. Ducted Sources--

Source gas mass flow rate will be determined either by measurements using standard methods described in the Federal Register and in standard engineering references such as Perry: Chemical Engineering Handbook, or by material balance calculations if sufficient source information is available. Before testing, approximation of the gaseous hydrocarbon concentrations will be made utilizing the Draeger gas detector with specific indicator tubes.

The ducted source sampling is based on process parameters; mass flow rates and sampling from a representative gas distribution point of the effluents; that is, approaching isokinetic sampling techniques. Uncontrolled sampling techniques would be satisfactory if only a total hydrocarbon emission rate was to be determined. However, this program must provide qualitative data as well as quantitative. To avoid sampling from points of stagnation and non-homogeneity in gaseous components, the selected sampling techniques are based on the following: sampling at an accessible point closest to the point of average gas flue velocity, maintain sampling rates approaching isokinetic but accommodating available nozzle size, break-through-volume limitations of the solid sorbents, and the high pressure drops inherent in packed columns of sorbents.



The sampling train components were described in Section 4.2.1.A and illustrated in Figures 4-2, 4-4, and 4-5.

The test data and process data will be recorded throughout the test. At the end of the test period the impingers will be sealed, labeled and delivered to the laboratory. The sorbent tubes will be removed from the train by disconnecting the flexible tubings from them. They will be capped with polyethylene caps, labeled and identified and placed into a glass wool packed PVC shipping tube and capped. The gas collection bulbs, bottles and bags will be closed, labeled and identified and shipped to the laboratory for analysis.

Wherever possible, a small sample of the process feed and that of the product will be obtained for analytical determinations, such as evaporation rate and vapor pressure. These data may be used to obtain a material balance calculation on the source. As a specific example in a test performed during Phase I on a dry cleaning plant, a 5-day/week, 6-hour/day cycle process, the measured emissions were 3.78 pounds/hr and the calculated emissions based on process make-up were 4.50 pounds/hr. The difference of 0.72 pound/hr could have evaporated from the holding tank during the 18 hour off time that it was open to the atmosphere through the process vents. This was verified by measuring the solvent evaporation rate in the laboratory and estimating the surface area of the solvent in the holding tank.

The utilization of the total hydrocarbon recording by the TLV sniffer not only helps in maintaining sampling rate but it is also a good indicator of either unexpected or standard process fluctuations further substantiating material balance data.

#### C. Fugitive Sources--

The measurement of emission rates for non-ducted or fugitive emissions will require a certain amount of ingenuity on the part of the test crew. As mentioned earlier, frequently these emissions are estimated or calculated on process data such as solvent make-up rates or on experimental data such as evaporation rates or emission factors for petroleum storage tanks. (Tank

emission rates are currently under intensive study by the Western Oil and Gas Association and the results should be available for use on this program.) In certain cases, it will be desirable to make selected measurements in order to estimate total emission rates. The most useful techniques for detecting and measuring leak rates involve the use of bubbling soap solutions and tenting with polyfilm sheeting. KVB plans to use this approach in refineries, chemical plants, etc. where leakage losses cannot be readily detected from the process flow rates.

The basic approach is to select an operating unit for testing. All of the accessible hydrocarbon-transfer fittings (valves, flanges, etc.) will be checked visually for signs of leakage (stains, etc.) and checked with soap solution, Figure 4-10. Fittings showing leakage with soap solution will be categorized as to their estimated leakage rate: low, medium, or high. Depending on the time available and the number of "leakers", a selected number of leakers will be tented and their emissions measured.

The basic test setup for measuring leakage rates are shown in Figure 4-7. The small Spectrex pump pulls a low rate of air through the polyfilm envelope. The air drawn into the envelope will be filtered to remove background hydrocarbon and may be metered with a rotameter as shown. The outlet air and hydrocarbon mixture will be metered and delivered to the TLV analyzer where the total hydrocarbon level will be measured continuously. When a steady state has been reached, the TVL analyzer should read a constant ppm level. Readings will be taken for several minutes. Then a Tedlar bag of the emissions will be taken. The total hydrocarbon leak rate will be determined by the following calculations:

$$HC = 1.36 \times 10^{-5} \text{ ppm}_{TLV} \times \frac{ft^3}{t}$$

where

HC = hydrocarbon leak rate, lb/hr

$\text{ppm}_{TLV}$  = parts per million total hydrocarbon concentration detected on TLV

$ft^3$  = meter reading on gas meter corrected to 60°F and 29.9 in. Hg, in cu. ft.

t = time in minutes  $ft^3$  was measured

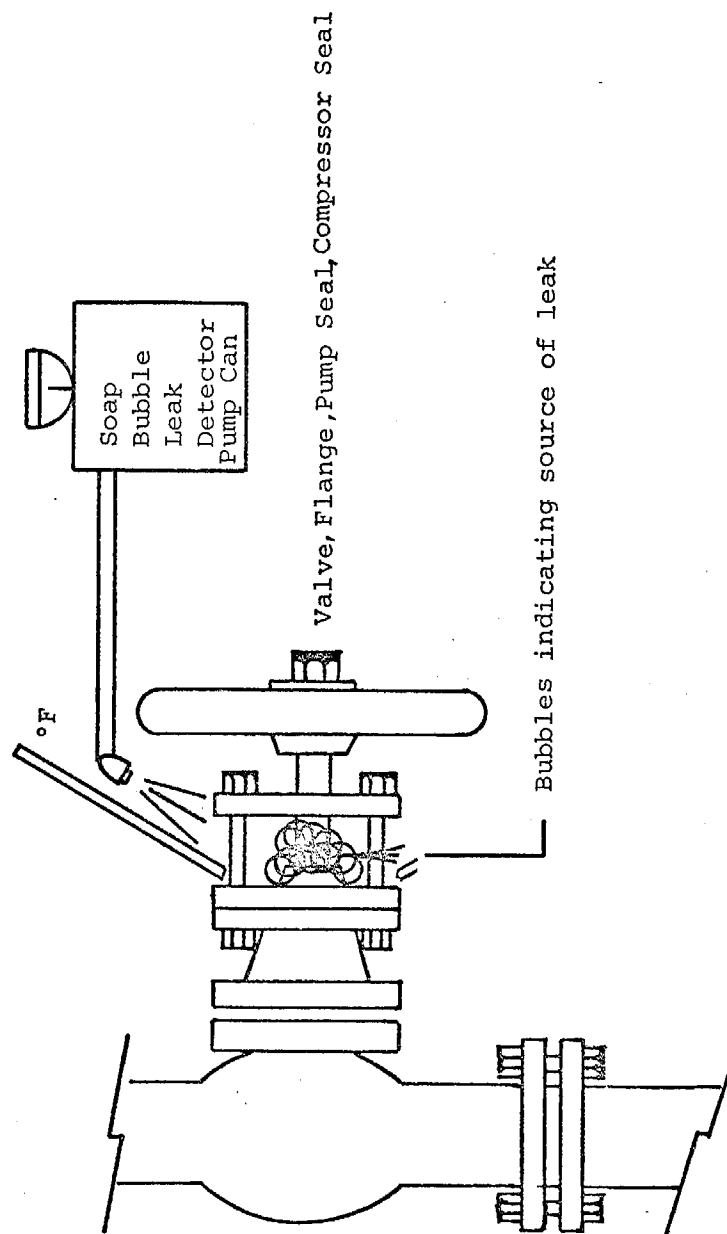


Figure 4.10. Soap bubble detection and temperature evaluation of hydrocarbon fittings.

This calculation will be checked with the data from the Tedlar bag. The volume of emissions collected in the bag and the filling time of the bag will be measured and recorded. The total hydrocarbon content of the bag will be determined by GC analysis in the laboratory as well as the specie breakdown and average molecular weight. From this information the total hydrocarbon emission rate can be determined to check the results determined by the TLV. The percent composition determined by GC analysis will then be used to apportion the total hydrocarbon emission rate among the various species.

Based on these measured leakage rates, the leakage rates for other fittings will be estimated on the basis of observing their performance during the soap-solution test. KVB also plans to experiment with the use of the TLV sniffer to determine relative total hydrocarbon emissions from these types of fittings. If this proves successful, it will be particularly valuable for use on hot fittings but could totally replace the use of the soap solution. Figure 4-10 illustrates such a test setup.

#### D. Test Data and Calculation Forms and Records--

In the field, the total volumetric emissions from a source will be measured in standard cubic feet/minute. The laboratory will provide composition data in the form of weight of individual specie per known volume or per unit volume (i.e.,  $\mu\text{g}$  or  $\mu\text{g}/\text{ml}$ ). The calculations required to convert these data to weight/unit time of the individual species will be performed using the test data and calculation sheets presented in Appendix C.

#### 4.2.2 Laboratory Analysis

Considering the organic hydrocarbon species expected to be encountered for the various industrial source-type categories listed by Trijonis and Arledge (Ref. 4.5), analytical methods must be selected to accommodate such samples. The general suitability of gas chromatographic techniques applied to environmental hydrocarbon analysis has been extensively reviewed (Ref. 4.6).

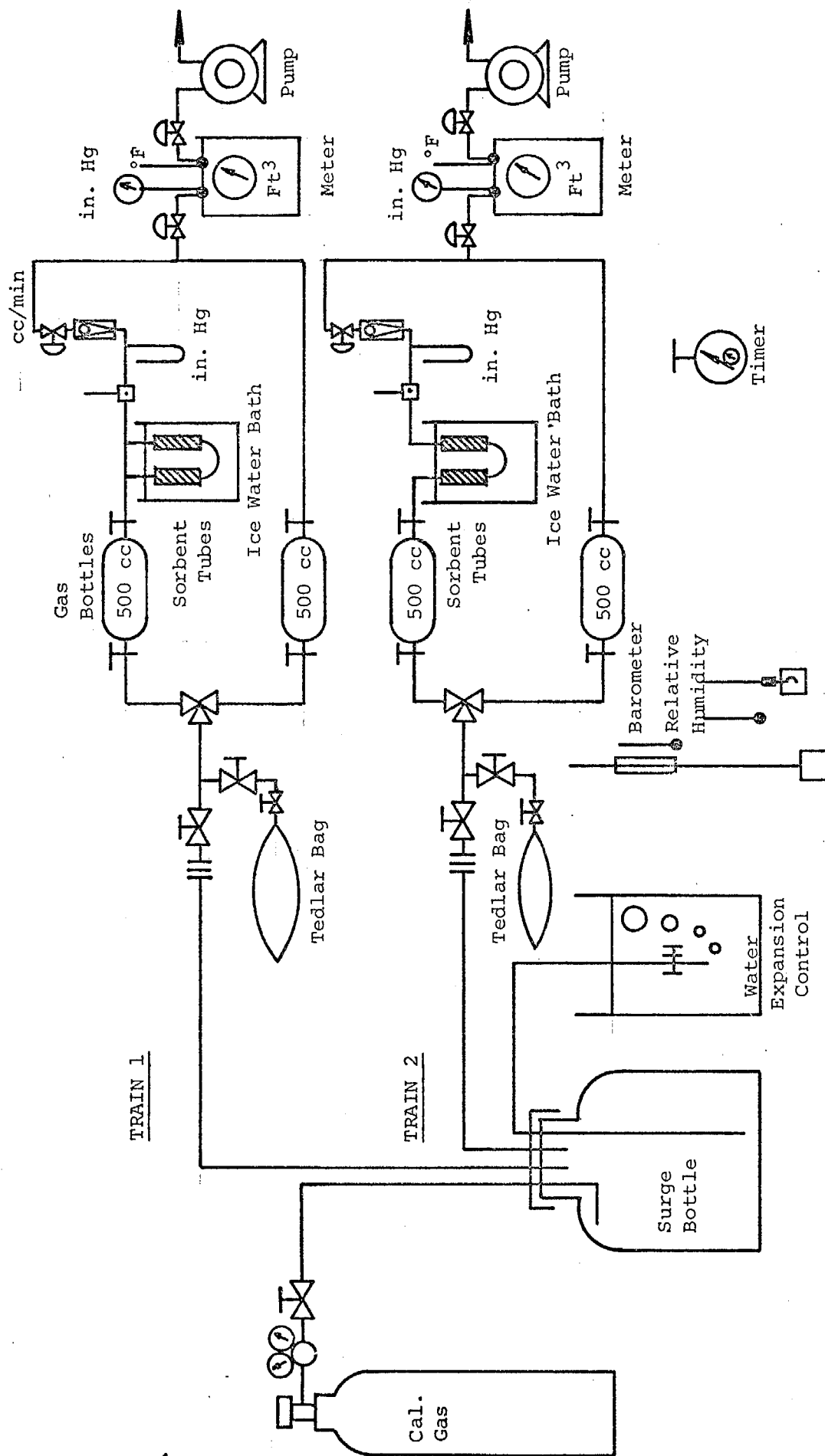


Figure 4.11. Sampling trains in QC test with calibration gas.

5804-483

Environmental analysis for trace organics has been revolutionized by introducing the GC effluent into a mass spectrometer. Combined GC/MS techniques have been successfully applied over a broad range of organic materials including alkane, alkene, and aromatic hydrocarbons (Ref. 4.7). The general utility of the GC/MS technique for analysis of the heavier aliphatic and aromatic hydrocarbons has been demonstrated by Raymond and Geriochon (Ref. 4.8). Much of the data published on the occurrence of hydrocarbons in polluted air sheds have been acquired by these techniques (Refs. 4.6-4.12). ARLI has extensive expertise in gas sample analysis for Naval hyperbaric diving gases and NASA system using GC and GC/MS procedures (Refs. 4.13-4.28).

Field samples will arrive for analysis at ARLI either in gas-collection bottles, Tedlar bags or tubes of charcoal sorbent. Sample injection on chromatographs will be accomplished using a gas sampling loop (Ref. 4.12); solvent stripping (Refs. 4.1-4.4, 4.26) of sorbent components. Since chromatography performance can be optimized if the genera of analytes can be anticipated (e.g., ketones, alkanes, etc.), the laboratory will be advised by the field test crew as to the source of the sample and the process chemicals involved. The choice of chromatographic column liquid phase (OV-101, OV-17, OV-225, Carbowax 20 M, etc.) or solid polymer type columns (Porapak Q, Durapak, etc.) will be determined by the particular source type under investigation. Where information on gas compositions for a particular source type is not obtained by the test crew, the Trijonis report (Ref. 4.5) will be consulted to provide correlation between source types and genera of organic compounds, e.g., rotogravure printing-primary and secondary alcohols; linear, branched or cyclic aliphatics; acetates. Large bore packed columns, SCOT or glass capillary columns will be used where appropriate. ARLI has found the performance of glass capillary columns (J. & W Scientific) to be superior, with typically 60,000 theoretical plates being available.

The molecular components from the GC column effluent are split 1:1 between the FID unit and a MS interface line, using a glass jet Ryhage separator (Refs. 4.29, 4.30) for analyte introduction into the mass

spectrometer. This configuration allows simultaneous quantification (based on FID response) and identification (via MS cracking patterns). Cracking patterns will be interpreted manually, using suitable reference works (Refs. 4.31-4.35). Cyphernetics computerized searching will further assist identifications as necessary.

For ten major source types (utility boiler, rubber plant, plastics plant, agricultural chemical, paint booth, degrease tank, oil well, refining emission, printing press and domestic solvent), samples will be analyzed by mass spectrometry without prior GC separation. The mass spectra thus obtained will be very complex. They will be compared to the mass spectra expected from a combination of those compounds subsequently identified by GC. If, at a later date, anyone chooses to challenge the source type characterization on the basis of incomplete qualitative identification of the major components, this mass spectrum can be used to show that all major components were accounted for.

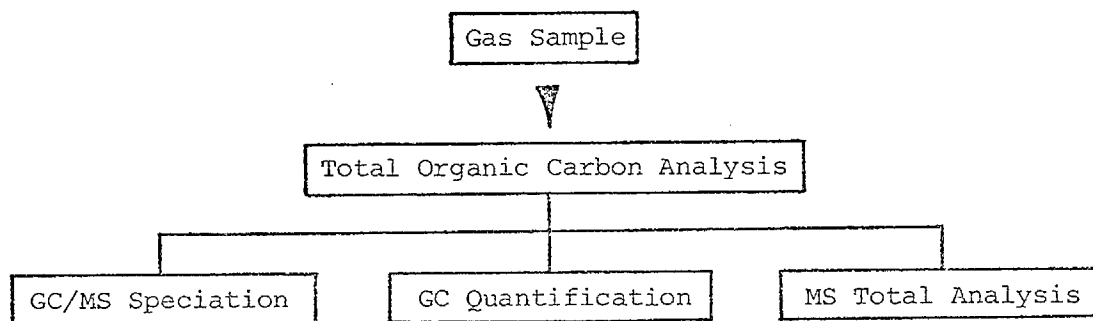
It is expected that an infinite variety of chemical compounds are possible for certain source types, i.e., oil well, refineries. Therefore, to expedite analysis only GC peaks which contribute greater than 1% of the total flame current integration area will be identified. This policy of concentrating on significant species will greatly expedite analysis time.

All samples will be analyzed for total organic carbon (TOC). The matrix of sample analysis to be followed by ARLI is presented in Table 4-6. The TOC results will be used to direct further GC analysis methodologies, i.e., ambient vs. cryogenic temperature of the sample injected through a gas sample loop. Drager tubes will be used by field sampling teams to indicate presence of chromatographically difficult species such as formaldehyde, amines, sulfides. If their presence is shown, impingers and classical wet chemical determinations, i.e., chromotropic acid determination of formaldehyde, will be used.

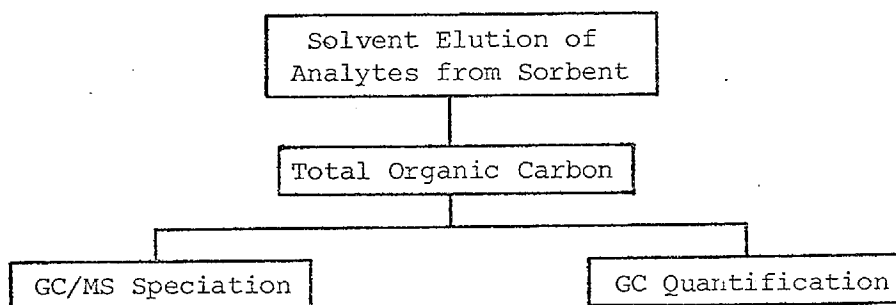
TABLE 4-6. MATRIX OF LABORATORY ANALYSIS

Field Sampling Train Generates Three Types of Samples:

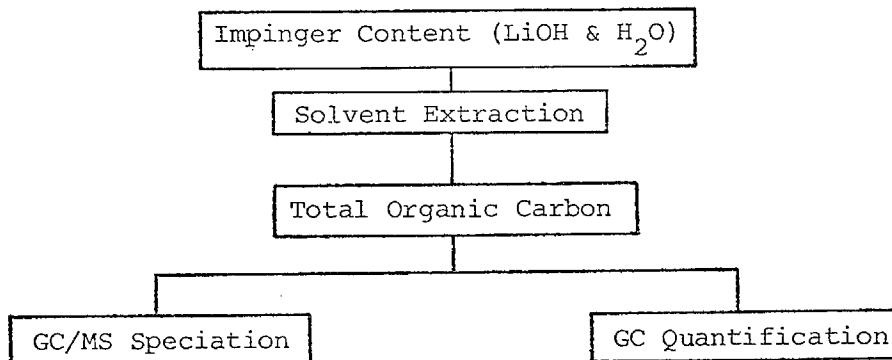
I. Tedlar Bag or Pyrex Flask



II. Sorbent Bed Analysis



III. LiOH Trap from Combustion Sources



5804-483



Composition profiles will be prepared by the laboratory for each sample submitted for GC analysis. A typical printout of a composition profile is presented in Table 4-5. The ARB Code refers to the three-class reactivity classification. THE EPA Number refers to the SAROAD (Ref. 4.36) number for the specific compound. Note that where the EPA code fails to include a compound, the laboratory will arbitrarily assign a number in the proper sequence. Where this is done the number will be marked with a # sign as indicated.

Instrumental calibrations are routinely done on a daily basis using appropriate standards. ARLI serves as the analytical laboratory for Airco, providing analytical label data for many of that firm's specialty gases. ARLI uses an assortment of very dilute standards (e.g., hexane, benzene, vinyl chloride, etc.) purchased from Matheson, Precision Gas Products, and other specialty gas houses. In addition, specific component response calibration is accomplished using liquid or gaseous dilutions at several levels. If an MS identified compound is unobtainable commercially or is only obtainable in impure form and purification costs exceed achievable benefits, calibration is approached mathematically. That is, specific response is interpolated or extrapolated from data obtained on other members of the homologous series. Discussion of analytical precision and accuracy are presented in the Q.C. section above.

The calibration gases purchased for use on the present program were obtained from Precision Gas Products, Corporation.

#### 4.3 QUALITY ASSURANCE PROGRAM

Interwoven throughout the experimental program will be a quality assurance effort providing (1) interlaboratory analyses of identical samples for accuracy and precision checks, (2) calibration of meters, gauges and sampling instruments by NBS and ASTM methods, (3) frequent response factor calibration of laboratory instruments, (4) unannounced blank or zero-gas samples, (5) redundant samples taken concurrently from the same source and (6) lacing of field samples with externally-prepared calibration gases. This quality assurance program adopts and expands upon the philosophy outlined recently by the EPA (Ref. 4.37).

TABLE 4-7. TYPICAL LABORATORY GC ANALYSIS REPORT

SAMPLE NUMBER: DOUGLAS BAG KVB 10052A

ARB. CODE	EPA NUMBER	CHEMICAL NAME (ISOMERS)	MOL.WT	UG/L	%WT	PPM	%VOL
1	43201	METHANE	16.04	410.4	12.0	624.3	34.6
1	43202	ETHANE	30.07	239.2	7.0	194.1	10.7
3	43203	ETHYLENE	28.05	14.1	0.4	12.3	0.7
2	43204	PROPANE	44.09	469.5	13.8	259.8	14.4
2	43212	N-BUTANE	58.12	463.9	13.6	194.8	10.8
2	43214	ISO-BUTANE	58.12	127.7	3.7	53.6	3.0
2	43220	N-PENTANE	72.15	327.1	9.6	110.6	6.1
2	43221	ISO-PENTANE	72.15	175.6	5.1	59.4	3.3
2	43231	HEXANE	86.17	287.1	8.4	81.3	4.5
2	43232	HEPTANE	100.20	182.2	5.3	44.4	2.5
2	43233	OCTANE	114.23	118.9	3.5	25.4	1.4
2	43236	#ISOMERS OF HEXANE(3)	86.17	163.0	4.8	46.2	2.6
2	43237	#ISOMERS OF HEPTANE	100.20	146.4	4.3	35.7	2.0
2	43239	#ISOMERS OF OCTANE(4)	114.23	246.2	7.2	52.6	2.9
2	43240	#CYCLOHEXANE	84.16	42.3	1.2	12.3	0.7
TOTALS				3413.6	100.0	1806.6	100.0

2 COMPOUNDS OF ARB CLASS I  
 17 COMPOUNDS OF ARB CLASS II  
 1 COMPOUNDS OF ARB CLASS III

# DENOTES CMPDS WITH EPA NO. ASSIGNED BY ARLI

5804-483

During Phase I an extensive analytical program was conducted to establish assurance in sampling and analysis for stationary pollution source studies. This included an evaluation of field sampling equipment, laboratory gas sampling, instrument variability, standardization of gas chromatographic analysis columns, accuracy and precision of data. To test these parameters, the above four groups of calibration gases were procured in "K" bottles from Precision Gas Products, Inc. including selected (1) aliphatic hydrocarbons, (2) aromatic hydrocarbons, (3) oxygenated organics and (4) halogenated organic compounds. Concentrations were specified and controlled by the KVB program manager who retained certifications until analyses were performed.

Upon receipt of the four "K" bottles, three sets of samples were prepared in 250 ml gas collection bottles by KVB and delivered to ARLI, the SC APCD laboratory in Los Angeles and the ARB laboratory in El Monte. (Only the aliphatic and aromatic samples were sent to the ARB.) The results of these analyses are presented in Tables 4-8 through 4-11. Added to each standard as a control compound was hexane selected because of its unreactive nature and low adsorptivity.

Two of the sampling trains shown in Figure 4-1 were used to collect samples of the four calibration gases using the setup shown in Figure 4-11. Results of the analyses of these samples are compared to other analyses of these calibration gases using various handling and analysis methods are presented in Tables 4-12 through 4-15 and discussed below.

Recovery studies using the aliphatic hydrocarbon standard indicate some limitations in sampling or analysis. For example, when the collection train was used as shown in Case 5 of Table 4-12, 32 liters of gas at the selected flow rate of 3 liter/minute showed a breakthrough of low molecular weight hydrocarbons on charcoal. This, of course, does not effect sample collection because the intended use of the adsorbents were for compounds boiling above 80°F. Low values reported for butadiene clearly indicate polymerization or decomposition. The analytical data for Case 2 shows a

TABLE 4-8. QUALITY ASSURANCE ALIPHATIC STANDARD

All data are reported in ppm in nitrogen.

Compound	Certified Contents*	Analytical Results		
		ARLI	SCAPCD	CARB
Ethylene	51	50	21	D <sup>§</sup>
Propane	53	47	27	32
Propylene	53	57	32	30
1,3-Butadiene	51	3 <sup>#</sup>	28 <sup>+</sup>	28
Isobutane	NR	NR <sup>‡</sup>	NR	0.4
Hexane	50	50	30	40
Heptane	51	46	24	D
(Iso)Octane	50	43	26	D

\*Analytical information prepared by Precision Gas Products Co.

<sup>+</sup> Identified as Butene<sup>-1</sup>

<sup>§</sup>D = Identified but not quantified (insufficient sample)

<sup>#</sup>The ARLI recovery of butadiene was significantly below the certified composition. This was apparently caused during thermal desorption treatment of the sample bottle and transfer equipment. SCAPCD and CARB labs are believed not to have heated the sample bottles.

<sup>‡</sup>NR = not reported

5804-483

TABLE 4-9. QUALITY ASSURANCE AROMATIC STANDARD

All data reported in ppm in nitrogen.

Compound	Certified Contents	Analytical Results		
		ARLI	SCAPCD	CARB
Benzene	52	50	15	34
Toluene	48	46	11	34
Ethylbenzene	49	51	5	20
Chlorobenzene	50	51	3	NR
Hexane	49	50	20	35
Xylene	NR	NR	3	D

NR = Not reported

TABLE 4-10. QUALITY ASSURANCE HALOGENATED  
HYDROCARBON STANDARD

All data reported in ppm in nitrogen.

Compound	Certified Contents	Analytical Results	
		ARLI	SCAPCD
Freon 113	48	47	22
Hexane	50	50	5
Methyl Chloride	55	48	NR
1,1,1 Trichloroethane (Methyl chloroform)	50	46	37
Chloroform	49	46	49

NR - Not reported

KVB 5804-483

TABLE 4-11. QUALITY ASSURANCE OXYGENATED  
ORGANICS STANDARD

All data reported in ppm in nitrogen.

Compound	Certified Contents	Analytical Results	
		ARLI	SCAPCD
Methanol	53	4	NR
Acetone	52	43	7
Isopropanol	NR	NR	9
Methyl Ethyl Ketone (2-Butanone)	51	45	2
Methyl Isobutyl Ketone	48	NR	20
n-Hexanone	NR	42	NR
Hexane	48	50	37

KVB 5804-483

TABLE 4-12. RECOVERY STUDIES USING THE ALIPHATIC STANDARD

Analysis by Gas Chromatography - Porapac Q Column Temperature Programmed  
Reported as ppm of Component in Nitrogen

Compound	Case 1	Case 2	Case 3	Case 4		Case 5	
				Grab	Sorbent Tube Front Back	Grab	Sorbent Tube Front Back
Ethylene	51	50	46	33	0 0	29	0 0
Propane	53	47	47	37	14 0	32	12 8
Propene	53	57	48	30	14 0	27	10 9
1,3-Butadiene	51	3	33	8	25 0	8	24 (0.2)
n-Hexane	50	50	49	35	46 0	33	35 1
n-Heptane	51	46	49	36	43 0	36	44 0
(Iso)Octane							
(2 Methyl Heptane)	50	43	45	34	43 0	32	45 0
Total Recovery	359	296	317	213	185	197	198

Case 1. Certified contents - gravimetrically prepared.

Case 2. Glass-Teflon grab sample, GC analyzed on receipt; sample bottle and transfer lines heated during sampling and analysis.

Case 3. Glass-Teflon grab sample - sampled and analyzed without heating during transfer process.

Case 4. Glass-Teflon grab sample and activated carbon sorption tube using field sampling train - first test. 27.7 liters of standard gas sampled.

Case 5. Same sampling conditions as for Case 4 - second test. 32 liters of standard gas sampled.

KVB 5804-483

TABLE 4-13. RECOVERY STUDIES USING THE AROMATIC STANDARD  
Analysis by Gas Chromatography - Porapac Q Column Temperature Programmed  
Reported as ppm of Component in Nitrogen

Compound	Case 1		Case 2		Case 3		Case 4		Case 5	
	Grab	Sorbent Tube	Grab	Sorbent Tube	Grab	Sorbent Tube	Grab	Sorbent Tube	Grab	Sorbent Tube
n-Hexane	49		50		40		43	45 + 2	44	45 + 3
Benzene	52		50		43		47	45 + 2	47	46 + 4
Toluene	48		46		26		28	45 + 1	23	47 + 3
Ethylbenzene	49		51		23		25	46 + 1	20	49 + 3
Chlorobenzene	50		51		45		48	37 + 1	46	39 + 3
Total Recovery	248		248		177		191	218 + 2	180	226 + 3

Case 1. Certified contents - gravimetrically prepared.

Case 2. Glass-Teflon grab sample, GC analyzed on receipt; sample bottle and transfer lines heated during sampling and analysis.

Case 3. Glass-Teflon grab sample - sampled and analyzed without heating during transfer process.

Case 4. Glass-Teflon grab sample and activated carbon sorption tube using field sampling train - first test. 30 liters of standard gas sampled.

Case 5. Same sampling conditions as for Case 4 - second test. 28 liters of standard gas sampled.

KVB 5804-483



TABLE 4-14. RECOVERY STUDIES USING THE HALOCARBON STANDARD  
Analyzed by Gas Chromatography - Porapac Q Column Temperature Programmed  
Reported as ppm of Component in Nitrogen

Compound	Case 1		Case 2		Case 3		Case 4		Case 5
	Grab	Sorbent Tube	Grab	Sorbent Tube	Grab	Sorbent Tube	Grab	Sorbent Tube	
Hexane	50	50	44	33	40	38			49 + 3
Methylenechloride	55	48	<0.1*	<0.1	<0.1	<0.1			50 + 3
Chloroform	49	46	15	28	19	31			33 + 1
Methyl Chloroform (1,1,1-Trichloroethane)	50	46	<1	30	<1	34			41 + 2
Freon 113 (1,1,2-Trichloro, 2,2,1-Trifluoroethane)	48	47	37	21	34	28			33 + 3
Total Recovery	252	237		112		131			206 + 3

\*MeCL<sub>2</sub> masked by solvent.

Case 1. Certified contents - gravimetrically prepared.

Case 2. Glass-Teflon grab sample analyzed on receipt of standard sample bottle and transfer lines heated during sampling and analysis.

Case 3. Glass-Teflon grab sample and activated carbon sorption tube using field sampling train - first test. 24 liters of standard gas sampled.

Case 4. Same as Case 3, second test. 28 liters of standard gas sampled.

Case 5. Glass-Teflon grab sample analyzed approximately 45 days after sample receipt. Heated transfer lines and heated grab sample during analyses.

TABLE 4-15. RECOVERY STUDIES USING OXYGENATED ORGANICS STANDARD  
Analysis by Gas Chromatography - Porapac Q Column Temperature Programmed  
Reported as ppm of Component in Nitrogen

Compound	Case 1		Case 2		Case 3		Case 4		Case 5	
	Grab	Sorbent Tube	Grab	Sorbent Tube	Grab	Sorbent Tube	Grab	Sorbent Tube	Grab	Sorbent Tube
Hexane	48	42	Recovery*	39	*	47	*	47	*	47
Methyl Alcohol	53	4	Less	<1	*	<1	*	<1	*	<1
Acetone	52	43	Than	25	*	28	*	28	*	28
Methyl Ethyl Ketone (2-Butanone)	51	45	ppm Level	39	*	47	*	47	*	47
Methyl Isobutyl Ketone (2-Hexanone)	48	42		33	*	39	*	39	*	39
Total Recovery	252	176		136		161		161		161

\*The oxygenated material could not be displaced from the sampling container without heating because of adsorption or moisture and absorption.

Case 1. Certified contents - gravimetrically prepared.

Case 2. Glass-Teflon grab sample analyzed by GC on receipt of standard mixture. All transfer lines and sampling system heated.

Case 3. Same as Case 2 without heating.

Case 4. Glass-Teflon grab sample and activated carbon sorption tube using field sampling train - first test. 28 liters of standard gas sampled.

Case 5. Same as Case 4, second test. 23.8 liters of standard gas sampled.

recovery of only 3 ppm when the sampling container was heated to approximately 120°F during transfer to the chromatograph. Case 3 of the gas sample was transferred to the GC loop without heating (33 ppm of butadiene was recovered). Because ARLI and the other referee laboratories found approximately 30 ppm of butadiene in all tests, it can be assumed that the gas phase of the Precision Gas Standard contains only this amount. Either wall adsorption or catalytic polymerization within the "K" bottle could explain the difference between the analyzed and gravimetrically prepared material. The accuracy observed for sorbent collected hydrocarbons above  $C_5$  lies within experimental error. It also appears that some heating of the glass grab sample containers is required if comparable results are to be achieved. The laboratory will make further studies on thermal desorption limits, although a tentative limit of 100°F will be used for all current field sampling analytical work. Recoveries of the lower hydrocarbons,  $< C_4$ , in grab samples should improve with warming.

Table 4-13 shows the data obtained on the aromatic hydrocarbon gas standard sample. These data show that accuracy can be achieved within the limitations of analytical repeatability. Toluene and ethylbenzene apparently require grab sample bottle warming to reduce wall-adsorption effects. Unexplained retention of chlorobenzene on the activated carbon was observed although 80% recoveries of higher molecular weight compounds are considered acceptable by most laboratories and government agencies. It is ARLI's considered opinion that no corrections should be made for hydrocarbon sampling to actual and projected stack emissions.

Table 4-14 reflects the analytical studies made on halocarbon gas mixtures. These data are not consistent with the accuracy and reproducibility of the hydrocarbon data. It would appear that for the higher molecular weight halogenated materials, between 20 and 30% losses occurred simply on standing in the metal "K" bottle. Case 5 of Table 4-14 illustrates this condition. The loss of methylene chloride in grab sampling appears to be real although in ARLI's previous experience with analyzing for traces of methylene chloride there has been no problem. Methylene chloride essentially elutes with carbon disulfide from a Porapac GC column. Therefore, no accurate

measure of concentration could be made. The reported value of  $< 0.1$  ppm appears to be a small shoulder on the solvent peak and is probably an impurity in one or both of the compounds. Recoveries of hexane from the desorbed carbon were also unexpectedly low. It is our intention to perform minimum but continued effort on this standard mixture until greater accuracies can be achieved with the sampling train. The use of flexible tubing or materials that can react with this class of compounds will be minimized in the sampling train. Until such time as a higher confidence level can be achieved or the problems of sample loss resolved, no analytical corrections are recommended for emission projections.

Table 4-15 presents the results obtained for oxygenated organic materials. If it can be assumed that the amount of methyl alcohol found in the "K" bottle by analysis, restandardization, and reanalysis (as was actually performed in the laboratory) is correct, the recoveries are within 20%. Methyl ethyl ketone elutes with hexane from the Proapac Q column. However, from other recovery data, standards and grab samples of the Precision Gas mixture, and response factors applied to the measured area, the calculated concentration reported under Case 4 and 5 agree within the experimental limits.

The oxygenated materials are strongly adsorbed on the glass bottle walls. This is apparent in the data present for the grab-train samples of Case 4 and 5 as well as the ambient grab sample of Case 3. All field grab samples that are expected to contain oxygenated materials will be warmed and the transfer lines maintained at an elevated temperature injection into the GC. Also Durapac column will be used with a Proapac column for these samples.

A secondary standard mixture containing hexane, methyl alcohol, isopropyl alcohol, ethyl alcohol and methyl cellosolve is being prepared. Concentrations of each ingredient will be approximately the same as the Precision Gas Mixture.

The analytical data presented above suggest quantitative analyses can be obtained by grab and sorbent sample collection. The need for heating gas bottles is important in order to reduce or eliminate wall adsorption. Overheating does affect conjugated unsaturated hydrocarbons and particular care will be taken to avoid this condition. The carbon desorbate will also be examined on a silicone column for higher molecular weight hydrocarbons.

In summary, these data indicated that most compounds, excluding conjugated unsaturated hydrocarbons (e.g. butadiene) and the lowest boiling alcohols, can be quantitatively collected and analyzed using normal sampling and analytical laboratory practices. Thermal and solvent stripping of collecting devices and sample containers produced quantitative analytical recoveries within a confidence level of  $\pm 20\%$ . Aliphatic and aromatic hydrocarbons are only slightly adsorbed in the collection system while oxygenates are strongly adsorbed and halocarbons show apparent decomposition during extended storage in metal containers or collection systems. The heating of gas collection bottles to 100-120°F during the transfer of sample to the gas chromatograph will be used to maximize sample recovery. No correction will be applied to the analytical results to account for sample recovery efficiency since the apparent error in the results is well within expected variations in the processes included in the hydrocarbon inventory program.

During Phase II the quality assurance program will continue for the purpose of assessing the measurement error. Total organic content (TOC) measurements will be made with the Bacharach TLV sniffer (Section 4.1.2.B) in the field and by the laboratory using a custom-made apparatus in which the organic compounds are burned yielding CO and CO<sub>2</sub> which are reduced to methane using hydrogen and a Ranay-Nickel catalyst bed in a La Sabtier Reactor (Ref. 4-38). The methane is then measured in a flame ionization detector which is calibrated to read TOC expressed as hexane. These TOC values will be used as a continuing check on the subsequent GC analyses of the samples.

For each of the major source types listed below, three redundant field samples will be collected simultaneously. All three samples will be analyzed with normal GC or GC/MS techniques. One of the samples will be analyzed by mass spectrometry without prior GC separation. The mass spectrum thus obtained will be very complex in many cases and will not be analyzed immediately. However, it can be compared to the mass spectrum expected from a large combination of those of the compounds identified by GC. If any large MS peaks appear which do not correspond to any of the compounds identified by GC, then a major component of the mixture will have been missed. Conversely, if at a later date, anyone chooses to challenge the analyses on the basis of poor qualitative identification of the major components, the mass spectrum can be used to show that all the major compounds were, in fact, identified.

The major source types to be subjected to the redundant sampling are as follows:

1. Utility boiler
2. Rubber plant
3. Plastics plant
4. Agricultural chemical
5. Paint booth
6. Degrease tank
7. Oil well
8. Refinery emission (crude storage tanks)
9. Printing press
10. Domestic solvent (house paint vehicle)

KVB's proposal to have one sample from each of these categories analyzed by the ARB could not be arranged.

## SECTION 5.0

### REFERENCES

#### REFERENCES FOR SECTION 2.0

- 2.1 California Air Resources Board, "Emission Inventory System - Procedures and Instructions for Adding and Changing Inventory Data," March 1976.
- 2.2 Linnard, Howard, California Air Resources Board, Private Communication, July 1975.
- 2.3 Dryan, R. J., "Point Source Emission Inventory for Los Angeles County," EPA-450/3-74-018, February 1974, and additional Basin counties by private communication with Pacific Environmental Services, August 1974.
- 2.4 Los Angeles County Air Pollution Control District, "1974 Profile of Air Pollution Control," (Data applicable to 1973), 1974.
- 2.5 County of Orange Air Pollution Control District, "Profile of Air Pollution Control - 1972," May 1973.
- 2.6 San Bernardino County Air Pollution Control District, "1973 Annual Report," 1973.
- 2.7 Santa Barbara County Air Pollution Control District, "Average Emissions of Contaminants 1970," 1970.
- 2.8 Rouge, J., County of Ventura Air Pollution Control District, "Emission Inventory for 1972," July 1973.
- 2.9 Riverside County Air Pollution Control District, "Air Contaminant Emissions," January 1971.
- 2.10 Trijonis, J. C. and K. W. Arledge, "Impact of Reactivity Criteria on Organic Emission Control Strategies In the Metropolitan Los Angeles AQCR," Preliminary Report for EPA Contract 68-02-1735, July 1975.
- 2.11 Dain, F. R. and R. E. Schwegler, "Energy Recovery from Landfills," Waste Age, March/April 1974.

#### REFERENCES FOR SECTION 3.0

- 3.1 Los Angeles Area Chamber of Commerce, Southern California Business Directory and Buyers' Guide, 1975.
- 3.2 Surprenant, K. S. and D. W. Richards, "Study to Support New Source Performance Standards for Solvent Metal Cleaning Operations," Dow Chemical Co., Midland Mich., Contract No. 68-02-1329, Task 9, Final Report, June 30, 1976.
- 3.3 Hughes, T. W., et al., "Source Assessment: Prioritization of Air Pollution from Industrial Surface Coating Operations," Monsanto Research Center, Contract 68-02-1320, Task 14, EPA 650/2-75-019-a, NTIS PB 243 423, February 1975.
- 3.4 International Fabricane Institute, "Experimental Study on Solvent Discharge from Drycleaning Establishments to the Environment," May 21, 1975.

#### REFERENCES FOR SECTION 4.0

- 4.1 Mueller, F. X. and J. A. Miller, "Determination of Organic Vapors in Industrial Atmospheres," Amer. Lab., 49-61, May 1974.
- 4.2 Levache, B. and S. M. MacAskill, "Analysis of Organic Solvents Taken on Charcoal Samplers," Anal. Chem., 48, (1) 76-78, 1976.
- 4.3 Nelson, G. O., et al., "Respiratory Cartridge Efficiency Statistics; VII. Effect of Relative Humidity and Temperature," Amer. Ind. Hyg. Assoc. J., 37 (5), 280-288, 1976.
- 4.4 Parkes, D. G., et al., "A Simple Gas Chromatographic Method for the Analysis of Trace Organics in Ambient Air," ibid, 37, (3), 165-173, 1976.
- 4.5 Trijonis, J. C. and K. W. Arledge, "Impact of Reactivity Criteria on Organics Emission Control Strategies in the Metropolitan Los Angeles AQCR," Preliminary Report for EPA Contract 68-02-1735, July 1975.
- 4.6 Altshuller, A. P., "Gas Chromatography in Air Pollution," J. Gas Chromatog., 1, 6, 1973.
- 4.7 Bruner, F., P. Piccioli, and S. Zelli, "Improved Double Detection Gas Chromatography-Mass Spectrometry Interface for the Analysis of Complex Organic Mixtures," Anal. Chem., 45, 1002, 1973.
- 4.8 Raymond, A., and G. Geriochon, "Gas Chromatographic Analysis of C<sub>8</sub>-C<sub>18</sub> Hydrocarbons in Paris Air," Environ. Science Technol., 8, 143, 1974.<sup>18</sup>
- 4.9 Lonneman, W. A., et al., "Hydrocarbon Composition of Urban Air Pollution," ibid, 8, 229, 1974.



- 4.10 Altshuller, A. P., et al., "Hydrocarbon Composition of the Atmosphere of the Los Angeles Basin - 1967," ibid, 5, 1009, 1971.
- 4.11 Stephens, E. R. and F. R. Burleson, "Distribution of Light Hydrocarbons in Ambient Air," JAPCA, 19, 929, 1969.
- 4.12 Stephens, E. R., "Hydrocarbons in Polluted Air," Statewide Air Pollution Research Center, Summary Report submitted to Coordinating Research Council, Project CA PA-5-68, June 1973.
- 4.13 Deuel, C. L., and R. M. Roberts, "Complete Analysis of Naval Hyperbaric Diving Gases," 1973 Diver's Gas Purity Symposium, Battelle-Columbus, Columbus, Ohio, November 1973.
- 4.14 Deuel, C. L., "Atmospheric Trace Analysis of Enclosed Systems," ARLI Annual Report No. 1002-2-0002AA to USAF School of Aerospace Medicine Contract No. F41609-72-C-0034, March 1973.
- 4.15 Deuel, C. L., Idem, Report No. 1002-1-0002AA, December 1972.
- 4.16 Deuel, C. L., "Chemical Analysis of Adsorbates from Breathing Canisters from Apollo 17 Spacecraft," ARLI Report No. 3002-17 to NASA Manned Spacecraft Center (MSC) on Contract No. NAS 9-8872, March 1973.  
  
Idem, Apollo 16, Report No. 3002-16, November 1972.  
Idem, Apollo 15, Report No. 3002-15, June 1972.  
Idem, Apollo 14, Report No. 3002-14, June 1971.  
Idem, Apollo 13, Aerojet-General Report No. 4108, October 1970.  
Idem, Apollo 12, Aerojet-General Report No. 4053, August 1970.  
Idem, Apollo 11, Aerojet-General Report No. 3856, December 1969.  
Idem, Apollo 10, Aerojet-General Report No. 3763, July 1969.  
Idem, Apollo 9, Aerojet-General Report No. 3745, June 1969.  
Idem, Apollo 8, Aerojet-General Report No. 3725, March 1969.  
Idem, Pre-Apollo 7, Aerojet-General Report No. 3726, March 1969.  
Idem, Apollo Spacecraft 101, Aerojet-General Report No. 3695, January 1969.
- 4.17 Deuel, C. L., and M. L. Moberg, "Trace Analyses of Human Breath Samples," USAF School of Aerospace Medicine Report No. SAM-TR-72-18, September 1972.
- 4.18 Deuel, C. L., "Collection and Measurement of Atmospheric Contaminant During Skylab A,/MDA Unmanned Altitude Chamber Test," ARLI Report No. 3003-F to NASA MSC on Contract No. NAS 9-91160, December 1972.
- 4.19 Deuel, C. L., "A Study of Physiochemical Factors Affecting Charcoal Adsorption of Contaminants in Manned Spacecraft Atmospheres," ARLI Report No. 1666-F to NASA MSC on Contract No. NAS 9-11049, September 1971.
- 4.20 Deuel, C. L., and M. L. Moberg, "Collection and Measurement of Atmospheric Trace Contaminants," NASA Report CR-111851, Langley Research Center, Virginia, December 1970.

- 4.21 Moberg, M. L. and C. L. Deuel, "Measurement of Trace Atmospheric Constituents in the 90 Day Space Station Simulator," 90 Day Manned Test Symposium, NASA Langley Research Center, Hampton, VA, November 1970.
- 4.22 Deuel, C. L., "Chemical Analysis of Cryogenically Trapped Samples from the LTA-8 and 2TV-1 Series Tests," Aerojet-General Report No. 3730 to NASA MSC on Contract No. NAS 9-9005, April 1969.
- 4.23 Deuel, C. L., "Chemical Analysis of Cryogenically Trapped Samples from 90003 to 90004 Test Series," Aerojet-General Report No. 3684 to NASA MSC on Contract No. NAS 9-9005, January 1969.
- 4.24 Deuel, C. L., "Trace Gas Analysis on Samples from Apollo 101, 2TV-1 and LTA-8 Series," Aerojet-General Report 3649 to NASA John F. Kennedy Space Center on Contract No. NAS 10-6183, November 1968.
- 4.25 Deuel, C. L., "Trace Gas Analysis of Atmosphere from Apollo 103 and LEM 3 Command Modules," Aerojet-General Report 3596 to ibid, November 1968.
- 4.26 Wood, G. D. and R. G. Anderson, "Personal Air Sampling for Vapors of Aniline Compounds," Amer. Ind. Hyg. Assoc., J., 36, (7), 538-548, 1976.
- 4.27 Pellizzari, E. D., J. E. Bunch, R. E. Berkley, and J. McRae, "Collection and Analysis of Trace Organic Vapor Pollutants in Ambient Atmospheres," Analytical Letters, 9, 45, 1976.
- 4.28 Parson, J. S. and S. Mitzner, "Gas Chromatograph Method for Concentration and Analysis of Traces of Industrial Organic Pollutants in Environmental Air and Stacks," Environ. Sci. Technol., 9, 1053, 1975.
- 4.29 Krueger, P. M. and J. A. McCloskey, "Porous Stainless Steel as a Carrier Gas Separator Interface Material for Gas Chromatography - Mass Spectrometry," Anal. Chem., 41, 1930, 1969.
- 4.30 Watson, J. T. and K. Bremian, "Direct Recording of High Resolution Mass Spectra of Gas Chromatographic Effluents," Anal. Chem., 37, 844, 1965.
- 4.31 Cornu, A. and R. Massot, Compilation of Mass Spectral Data, Heyden and Son Ltd., London, U.K., 1966 (and supplements).
- 4.32 Index of Mass Spectral Data Listed by Molecular Weight and Six Strongest Peaks, ASTM, Philadelphia, 1969.
- 4.33 Eight Peak Index of Mass Spectra, (Vols. I & II), AWRE, Aldermaston, U.K., 1970.

- 4.34 Stenhagen, E., et al., Atlas of Mass Spectral Data, (Vols. I, II & III), Interscience Publishers, N.Y., 1969.
- 4.35 API 44-Mass Spectral Data, Texas A&M University, 1971.
- 4.36 Fair, D. H., J. B. Clements and G. B. Morgan, "AROAD Parameter Coding Manual," Office of Air Programs Publication No. APTD-0633, July 1971.
- 4.37 "Quality Control Practices in Processing Air Pollution Samples," EPA PB-230 890, March 1973.
- 4.38 Federal Register, Vol. 36, pages 22394 to 22396, November 25, 1971. (EPA's specification on a continuous or semi continuous measurement of nonmethane hydrocarbons and total hydrocarbons.)



APPENDIX A  
POTENTIAL TEST LOCATIONS



# POTENTIAL TEST LOCATIONS

<u>SIC</u>	<u>Description</u>	<u>Possible Test Location</u>	Plant Emission† Rate <u>Tons/Year</u>
25	<u>Furniture &amp; fixtures</u>	Marsprings, LA	130
		Gillespie Furn. Co., LA	410
		Rowe Furniture, Sylmar	218
		Bauman/Watz, Sylmar	214
		Calif. Furn. Shops Ltd., LA	136
		Good Tables, Carson	178
		LA Period Furn., Santa Barbara	193
		Morris Furn. Mfg., LA	134
		Questor Juvenile Furn., LA	117
		*B. P. John Furn., LA	355
		Mission Furn. Mfg. Co., LA	170
		Zeno Tables Co., Compton	147
		Steelcase, Inc., Tustin	142
		Wilshire Stor-All, LA	119
26	<u>General paper &amp; allied products</u>	Modern Pkgs., LA	248
		Crown Zellerbach, Commerce	900
		*Acme Ludlow Packaging, Temple City	545
		Fibreboard Corp., Vernon	200
		Potlatch Corp., Pomona	252
2641	Paper coating and glazing	Avery Label Co., LA	
2643	Bags (paper)	Chase Bag Co., LA	151
2649	Wallpaper	Albert Tan Luit & Co., LA	230
265	Paper board containers and boxes	Continental Can Co., LA	
		Container Corp. of America, LA	
27	Publishing & printing		
271	Newspapers	Rogers & McDonald Pub., LA	
272	<u>Periodicals</u>	*Calif. Rotogravure, LA	3,046
		Gravure West, LA	2,831
273	Books	Taylor Publishing Co., Covina	

\*Potential test site.

†Based on SCAPCD permit files.

<u>SIC</u>	<u>Description</u>	<u>Possible Test Location</u>	<u>Plant Emission Rate Tons/Year</u>
2752	Lithograph	Continental Graphics, LA	
2753	Engraving & plate	Shelmac Corp., LA	115
279	Printing Trade SA	Rogers & McDonald Pub., LA	
		Standard Paper Box Corp., LA	130
		Fibreboard Corp., LA	207
30	Rubber & plastic products		
301	<u>Tires &amp; tubes</u>	*Uniroyal, LA	1,480
		B.F. Goodrich, LA	699
		Firestone Tire Co., Commerce	550
3079	<u>Misc. plastic products</u>	*Robinson & Lamey, Fillmore	973
		Fibrerite Corp., Orange	60
		Allied Chemical Corp., LA	
		U.S. Polymeric, Santa Ana	268
	Plastic foam, polyurethane	United Foam Corp., LA	60
		Continental Can Corp., Santa Ana	
		Mica Corp., Culver City	176
	Plastic bags	Central Bag and Supply Co., LA	175
		Myers Drum Co., Montebello	167
34	Fabricated metal prod.	Myers Drum Co., LA	306
		Container Corp of America, LA	
3411	<u>Metal Cans</u>	National Can Corp., LA	320
		Continental Can Corp., Van Nuys	147
		General Can Corp., Upland	307
		National Can Corp., Etiwanda	310
		*Reynolds Metal Co., Torrance	438
		American Can Co., Carson	347
3429	Fasteners	Standard Pressed Steel, Santa Ana	186
3431	<u>Metal sanitary ware</u>	Kimstock, Santa Ana	244
		Robinson & Lamey, Fillmore	973
		*Day & Night Mfg. Co., LaPuente	866
344	<u>Fab. structural metal</u>	Soule Steel Co., LA	183
		*Western Metal Decorating, El Monte	306
		Pascoe Steel Corp., Pomona	237
		Western Metal Lathe, La Mirada	297



<u>SIC</u>	<u>Description</u>	<u>Possible Test Location</u>	<u>Plant Emission Rate Tons/Year</u>
347	Metal services	Imperial Metal Finishing, LA	188
353	<u>Construction machinery</u>	*Inland Ryerson Const. Prod., LA	386
		Freightliner Corp., Chino	215
3585	Refrigeration equip.	Day & Night Mfg. Co., LaPuente	866
359	Misc. machinery		
	Chemical milling	Aerochem, Orange	280
36	Electrical equipment	Robertshaw Controls Co., Anaheim	121
3630	<u>Household appliances</u>	Gaffers & Sattler, Inc. LA	219
		*Am. Appliance Mfg. Corp.	204
364	Electric lighting & wiring	ITT Cannon Electric, Santa Ana	142
3679	<u>Misc. elect. components</u>	3M Company, Camarillo	218
		Certron, Anaheim	315
		*Xerox Data Systems, Pomona	988
		Lockheed Electric, LA	222
37	<u>Transportation equip.</u>	*General Motors, South Gate	2,836
		General Motors, Van Nuys	1,238
		*Ford Motor Co., LA	715
372	<u>Aircraft &amp; parts</u>	*Lockheed California, Burbank	601
		Douglas Aircraft, Huntington Be.	
		Northrop, Hawthorne	522
		Airesearch Industrial Div., LA	192
		Douglas Aircraft, Torrance	416
		Rohr Industries, Chula Vista	208
		Lockhead California, Burbank	288
373	Ship & boat building (fiberglass)	Islander Yachts, Irvine	102
38	Instruments	Northrop, Anaheim	155
393	Musical instruments	F.E. Olds & Sons, Fullerton	179
394	Toys & sporting goods	Mattel, Inc., Hawthorne	

<u>SIC</u>	<u>Description</u>	<u>Possible Test Location</u>	<u>Plant Emission Rate Tons/Year</u>
395	Pens, art goods	Anja Eng., Monrovia	112

-----

CHEMICAL PROCESSING

28	Chemical & allied products		
281	Industrial chemicals		
	(Solvents)	Ashland Chemical Co., Santa Fe Spr.	
	(Polyesters)	Diamond Shamrock Chem., Oxnard	110
		Allied Chem. Corp., El Segundo	172
	(Flame proofing)	Flame-x-Control Corp., Van Nueys	128
		Union Carbide Chem., Co., Torrance	116
282	Plastic materials and synthetics	Uniroyal, Inc., LA	
		Ashland Chemical Co., LA	10
		Sylmar Div. Vistron Corp., Hawthorne	
283	Drugs & pharmaceuticals	Allergan Pharmaceuticals, Irvine	
284	Soaps, cleansers & toilet goods	Max Factor, El Segundo	41
2842	Cleaning compounds, floor waxes	Boyle-Midway, LA	
285	Paints & allied products	PPG Industries, Torrance	
2879	Agricultural chemicals (Insecticides)	Uniroyal, Inc., LA	
		Boyle-Midway, LA	
289	Miscellaneous		
2891	Adhesives	Morgan Adhesives Co., Cerritos	
		Fibrerite, Orange	60
2893	Printing inks	Inmont Corp., LA	
2899	Protective coatings	U.S. Polymeric, Santa Ana	268

# METALLURGICAL PROCESSING

<u>SIC</u>	<u>Description</u>	<u>Possible Test Location</u>	<u>Plant Emission Rate Tons/Year</u>
33	Primary metal industries		
331	Basic steel products	Kaiser Steel Corp., Fontana U.S. Steel Corp., Torrance	680 90
3240	<u>Steel fabrication</u>	Southwest Steel Rolling Mills, LA Soule Steel Co., LA	153 183
3361	Aluminum casting	Aluminum Co. of America, Vernon	216

# FOOD AND AGRICULTURAL PROCESSING

20	Food and kindred products		
201	Meet products	Cloughery Packing Co., LA	
202	Dairy products	Knudsen Corp., LA	
203	Canned cured & frozen foods (Citrus products)	Fillmore Piru Citrus As., Fillmore	
2032	Canned foods	Hunt-Wesson Foods, Fullerton	
2037	Frozen foods	Carnation Co., LA	
2079	Oils, vegetable	Swift Edible Co., Vernon	
208	Beverages		
2086	(Beer)	Anheuser-Busch, LA	
2084	(Wines)	San Antonio Winery, LA	
209	Misc. foods products (Fish products) (Potato chips)	Star Kist Foods, Inc., Term.Island Laura Scudders, Anaheim	

PROPOSED MINOR SOURCES TO BE TESTED

Plant Name	Location	Priority Class
<u>Petroleum</u>		
California Asphalt Co.	Santa Ana	I
Southern Pacific Pipeline	Bloomington	I
<u>Solvent Use</u>		
Rogers and McDonald Publishers	Los Angeles	II
Imperial Metal Finishers	Los Angeles	II
Crown Millerback	Commerce	I
Albert Van Luit & Co.	Los Angeles	II
U.S. Polymetric	Santa Ana	I
MICA Corporation	Culver City	II
Central Bay & Supply Co.	Los Angeles	II
AeroChem	Orange	II
Robertshaw Controls	Anaheim	II
3M Company	Camarillo	II
Islander Yachts	Irvine	II
F.E. Olds & Sons	Fullerton	II
Mattel, Inc.	Hawthorne	III
Arja Engineer	Santa Ana	III
ITT Cannon Electric Northrop	Anaheim	II
<u>Chemical</u>		
Diamond Shamrock Chemical	Oxnard	II
Allied Chemical Corp.	El Segundo	II
Uniroyal, Inc.	Los Angeles	II
Allergan Pharmaceutical	Irvine	II
Max Factor	El Segundo	III
PPG Industries	Torrance	III
Fibirite	Orange	III
Inmont Corp.	Los Angeles	III
<u>Metallurgical</u>		
Soule' Steel Co.	Los Angeles	II
Trent Tube	Fullerton	II
Alcoa	Vernon	II
<u>Food and Agricultural Products</u>		
Clougherty Packing Co.	Los Angeles	III
Fillmore Piru Citrus	Fillmore	II
Hunt Wesson Foods	Fullerton	III
Carnation Co.	Los Angeles	III
Swift Edible Oil Co.	Vernon	II
Anheuser Busch	Los Angeles	III
San Antonio Winery	Los Angeles	III
Starkist Foods	Terminal Island	III
Laura Scudders	Anaheim	III

Continued

Plant Name	Location	Priority Class
<u>One Each Of:</u>		
Crematory		II
Photofinishing Laboratory		III
Automotive Body Shop		II
Hospital Laboratory		III
McDonald's Restaurant		III
Kentucky Fried Chicken Restaurant		III
Commercial Heater		II
Domestic Heater		II
Domestic Barbecue		III
Domestic Cooking		III



APPENDIX B  
SOURCE QUESTIONNAIRES





# KVB

## ORGANIC COMPOUND EMISSIONS QUESTIONNAIRE

Mail Questionnaires To:

Mr. Tim Sonnichsen  
KVB, Inc.  
17332 Irvine Blvd.  
Tustin, CA 92680

Please Address All Questions To:

Mr. Hal Taback or  
Mr. Tim Sonnichsen  
KVB, Inc.  
(714) 832-9020

NOTE: ALL DATA SHOULD REPRESENT CALENDAR YEAR 1975.

### GENERAL INFORMATION

Company Name \_\_\_\_\_

Plant Address \_\_\_\_\_ City \_\_\_\_\_ Zip \_\_\_\_\_

Mailing Address \_\_\_\_\_ City \_\_\_\_\_ Zip \_\_\_\_\_

Person to Contact About Form \_\_\_\_\_

Telephone \_\_\_\_\_ Title \_\_\_\_\_

Approximate Number of Employees \_\_\_\_\_

Nature of Business (Include SIC) \_\_\_\_\_

Normal Operating Schedule

\_\_\_\_\_ Hrs/Day \_\_\_\_\_ Days/Week \_\_\_\_\_ Weeks/Year

Approximate Percent Seasonal Operation:

Dec.-Feb.	Mar.-May	June-Aug.	Sept.-Nov.

Are hydrocarbon or organic solvent containing materials such as cleaning fluids, coatings, adhesives, inks, etc. used in your operation?

\_\_\_\_\_ Yes \_\_\_\_\_ No If yes, please complete the appropriate forms

enclosed. Make additional copies if necessary. Copies of equivalent data summarized for 1975 may be submitted in lieu of completing the form. If no, please sign and return.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

## CONTROL AND STACK INFORMATION

1. A number should be assigned to each piece of equipment that emits hydrocarbons or to a number of similar units that are vented to a common stack. The Source No. below should correspond to those used in the sections which follow. If similar equipment has different control equipment, please split the source number to a, b, or c.
2. Identify the process or operation from which hydrocarbons are emitted. For example, dry cleaner, degreasing tank, spray booth, reactor, etc. If more than one unit is emitting to a common stack, specify the number of units.
3. Identify the primary hydrocarbon control method used such as after-burners, scrubbers, carbon adsorption, condensers, etc.
4. Indicate approximate efficiency if known.
5. Indicate installation date of control equipment.
6. If hydrocarbons are emitted from a stack, provide height, diameter, temperature, velocity, and flow rate information in appropriate columns. Design conditions may be used in lieu of actual test data.

[illegible]

PROTECTIVE OR DECORATIVE COATINGS OTHER THAN FABRIC COATING

1. Indicate Material Being Coated
2. Type and Amount of Coating Used:

[illegible]

3. Type<sup>s</sup> and amount of thinner used for dilution and cleaning not included above

Gal./yr.

Amount \_\_\_\_\_ Gal./Yr. \_\_\_\_\_

\*A source is an individual or similar pieces of equipment such as spray booths, tanks, dryers, etc. It should correspond to the Source on page 2. Use more than one entry if a source is employed for significantly different operations with different solvents.

† (1) paint, (3) varnish/shellac, (4) lacquer, (5) enamel, (6) primer

<sup>§</sup> If known, - acetone, isopropyl alcohol, MEK, butyl acetate, cellusolve, toluene, etc.

# 1975 normal operating period - hrs/day, days/wk, and wk/yr. If the approximate percent seasonal operation differs from that given on Page 1, please indicate.

(1) Material(s) Being Coated \_\_\_\_\_

(2) Type of Coating Process

[illegible]

(3) Type of cleaning solvent \_\_\_\_\_, Amount \_\_\_\_\_ (Gal/Yr)

(4) Is any solvent returned to supplier or collector?

No	Yes	Type	Amount	(Gal/Yr)

\*A source is an individual or similar pieces of equipment such as coaters, dryers, etc. It should correspond to the Source No. on page 2. Use more than one entry if a source is employed for significantly different operations with different solvents.

+polyvinyl chloride, polyurethanes, etc.

§ Toluene, naphtha, mineral spirits, MEK, xylene, chlorinated hydrocarbon, other (specify).

#1975 normal operating period - hrs/day, days/wk, and wk/yr. If the approximate percent seasonal operation differs from that given on Page 1, please indicate.

MISCELLANEOUS SURFACE COATING APPLICATION  
(Adhesives, Paper, Leather, Films, Glass, etc.)

(1) Material(s) Being Coated

(2) Type of Coating Process:

[illegible]

(3) Type 5 and additional amount of solvent used for dilution and cleaning not included above

, Amount Gal./Yr.

, Amount Gal./Yr.

\*A source number is an individual or similar pieces of equipment using surface coatings. It should correspond to the Source No. on page 2. Use more than one entry if a source is employed for significantly different operations with different solvents.

1. Adhesive type, pigment coating, barrier coating, polymeric coating, inorganic coating, etc.  
(specify).

§ Branched alcohol, linear alcohol, ethyl acetate, toluene, xylene, ethers, MEK, naptha, other (specify).

#1975 normal operating period - hrs/day, days/wk, and wk/yr. If the approximate percent seasonal operation differs from that given on Page 1, please indicate.

## DEGREASING OPERATIONS

- A. Type of Degreasing: \_\_\_\_\_ Cold Solvent Cleaning  
\_\_\_\_\_ Vapor Degreasing
- B. Type and Amount of Solvent Purchased for Degreasing Operations used in 1975

- |    |   |       |          |
|----|---|-------|----------|
| 1. | Stoddard                                  | _____ | Gal./Yr. |
| 2. | 1,1,1-Trichloroethane<br>(Chlorothene VG) | _____ | Gal./Yr. |
| 3. | Perchloroethylene                         | _____ | Gal./Yr. |
| 4. | Methylene chloride                        | _____ | Gal./Yr. |
| 5. | Trichloroethylene                         | _____ | Gal./Yr. |
| 6. | Other (specify)                           | _____ | Gal./Yr. |
| 7. | Other (specify)                           | _____ | Gal./Yr. |

- C. Suppliers of Solvents - Name, address, and phone no.

---

---

---

---

---

- #### D. Waste Solvent Disposal Method

.....

- E. Amount of Each Solvent Returned for Reprocessing to Vendor or Collector

- |    |                       |       |          |
|----|-----------------------|-------|----------|
| 1. | Stoddard              | _____ | Gal./Yr. |
| 2. | 1,1,1-Trichloroethane | _____ | Gal./Yr. |
| 3. | Perchloroethylene     | _____ | Gal./Yr. |
| 4. | Methylene chloride    | _____ | Gal./Yr. |
| 5. | Trichloroethylene     | _____ | Gal./Yr. |
| 6. | Other (specify)       | _____ | Gal./Yr. |

- F. Control Equipment (Other Than That Listed on Page 2)

---

# KVB

## DRY CLEANING

1. Amount of Clothes Cleaned per Year \_\_\_\_\_ Tons

2. Type of Dry Cleaning Unit

\_\_\_\_\_ Hot Unit (washing/extraction/drying in one machine)

\_\_\_\_\_ Transfer Unit (use of a separate recovery tumbler)

3. Type and Amount of Solvent Cleaner Used in 1975

Perchloroethylene \_\_\_\_\_ Gal./Yr.

Stoddard Solvent \_\_\_\_\_ Gal./Yr.

Other (Specify) \_\_\_\_\_ Gal./Yr.

Other (Specify) \_\_\_\_\_ Gal./Yr.

4. Supplier of Solvent - Name and Address

Perchloroethylene \_\_\_\_\_

Stoddard Solvent \_\_\_\_\_

Other (Specify) \_\_\_\_\_

Other (Specify) \_\_\_\_\_

- [illegible]

3. Type <sup>s</sup> and amount of solvent used for dilution and cleaning not included above:

Amount	Gal./Yr.
--------	----------

[illegible]

\*A source is an individual or similar printing machines, dryers, etc. It should correspond to the Source No. on page 2. Use more than one entry if a source is employed for significantly different operations with different solvents.

† solvent based. oil based, lacquer type, etc.

'solvent based, oil based, lacquer type) etc.  
 solvent based, oil based, lacquer type, MEK, other (specify).

#1975 normal operating period - hrs/day, days/wk, wks/yr. If the approximate percent seasonal operation differs from that given on Page 1, please indicate.



## KVB

## BULK SOLVENT STORAGE

Please complete the following information for each storage tank greater than 250 gallons capacity.

[illegible]

\* Submerged fill, splash fill, return vent line, adsorber.

## OPERATIONAL MODIFICATIONS

Please state the changes in type and estimated annual consumption of solvent planned for degreasing operations through 1980. Please include any information on control equipment additions or modifications.

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There is no text or other markings on the paper.

## FUEL BURNING EQUIPMENT

[illegible]

\*Source correspond to the Source No. on page 2.

† If gas fuel other than purchased natural gas is used, please submit latest fuel analysis. Please submit oil fuel analysis if employed as primary or auxiliary fuel.

<sup>3</sup> Should be in appropriate units Btu/lb or Btu/ft<sup>3</sup>.

# 1975 normal operating period - hrs/day, days/wk, and wks/yr. If the approximate percent seasonal operation differs from that given on Page 1, please indicate.

APPENDIX C  
DATA ACQUISITION FORMS



# KVB

Sample Codes

_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Test No. \_\_\_\_\_

Page A-

## SUMMARY OF RESULTS

Date \_\_\_\_\_

Name of Firm (see page C) \_\_\_\_\_

Plant Location (see page C) \_\_\_\_\_

Basic Equipment (see page B) \_\_\_\_\_

Control Equipment (see page B) \_\_\_\_\_

Equipment Tested (see page B) \_\_\_\_\_

Process Weight Per Hour (see page C) \_\_\_\_\_

Test: (see page C) \_\_\_\_\_

Sampling Station (see page D-1 & G) \_\_\_\_\_

Av. Gas Velocity, FPS (see page F) \_\_\_\_\_

Gas Temperature, °F (see page F&D-1) \_\_\_\_\_

Gas Flow Rate, SCFM (see page F) \_\_\_\_\_

Material Sampled (see page D-1 & G) \_\_\_\_\_

Time of Test-Begin (see page D-1) \_\_\_\_\_

Time of Test-End (see page D-1) \_\_\_\_\_

Net Sampling Time, Min. (see page D-1) \_\_\_\_\_

Conc., Gr./SCF (see pgs. B, D-2 & G) \_\_\_\_\_

Conc., Gr/SCF at 12% CO<sub>2</sub> (see pgs. B, D-2 & G) \_\_\_\_\_

Conc., Volume ppm (see pages B, D-2 & G) \_\_\_\_\_

Pounds/Hour (see pages B, D-2 & G) \_\_\_\_\_

Collection Efficiency, % (see page B) \_\_\_\_\_

Water Vapor, Vol. % (see page E) \_\_\_\_\_

CO<sub>2</sub>, Vol. % (Stack Cond.) (see page E) \_\_\_\_\_

O<sub>2</sub>, Vol. % (Stack Cond.) (see page E) \_\_\_\_\_

CO, Vol. % (Stack Cond.) (see page E) \_\_\_\_\_

N<sub>2</sub>, Vol. % (Stack Cond.) (see page E) \_\_\_\_\_

Tested by \_\_\_\_\_

# KVB

Sample Code \_\_\_\_\_  
 Test No. \_\_\_\_\_ Tested By \_\_\_\_\_  
 Date \_\_\_\_\_ Page B- \_\_\_\_\_

## SUMMARY: EMISSIONS TO ATMOSPHERE

Name of Firm \_\_\_\_\_  
 Location of Plant \_\_\_\_\_  
 Type of Operation \_\_\_\_\_  
 \_\_\_\_\_  
 Unit Tested \_\_\_\_\_  
 Efficiency of Control Equipment, % \_\_\_\_\_  
 Gas Flow Rate, SCFM \_\_\_\_\_ Gas Temp. °F \_\_\_\_\_ (see page D-1)  
 Test Method \_\_\_\_\_  
 \_\_\_\_\_

COMPOUNDS		ANALYZED		EMISSIONS		
Name	Mol. Wt.	ppm	ug	Gr./SCF	Lbs/Hour	Tons/year
Total:						

# KVB

Sample Code \_\_\_\_\_

Tested by: \_\_\_\_\_

Date \_\_\_\_\_

Page C \_\_\_\_\_

## STATEMENT OF PROCESS WEIGHT OR VOLUME

Firm Name \_\_\_\_\_

Address \_\_\_\_\_

### DATA ON OPERATING CYCLE TIME:

Start of Operation, Time \_\_\_\_\_

End of Operation, Time \_\_\_\_\_

Elapsed Time, Minutes \_\_\_\_\_

Idle Time During Cycle, Min. \_\_\_\_\_

Net Time of Cycle, Minutes \_\_\_\_\_

### DATA ON MATERIAL CHARGED TO PROCESS DURING OPERATING CYCLE:

Material	_____	Weight	_____	lbs, gal
Material	_____	or.	_____	lbs, gal
Material	_____	Volume	_____	lbs, gal
Material	_____		_____	lbs, gal
Material	_____		_____	lbs, gal
Material	_____		_____	lbs, gal
Material	_____		_____	lbs, gal

Total: \_\_\_\_\_

Signature \_\_\_\_\_

Title \_\_\_\_\_





## KVB

Sample Code \_\_\_\_\_

Firm Name and Unit \_\_\_\_\_

Test No. \_\_\_\_\_ Page D-2

Sampling Station \_\_\_\_\_ Date \_\_\_\_\_

SPOT MONITORING DATA BY DRAEGER OR TLV SNIFFER

[illegible]

# KVB

Sample Code \_\_\_\_\_

Firm and Unit \_\_\_\_\_

Test No. \_\_\_\_\_

Page E- \_\_\_\_\_

Sampling Station \_\_\_\_\_ Date \_\_\_\_\_

## WATER VAPOR AND GAS DENSITY CALCULATIONS

### Percent Water Vapor in Gases

- A. Gas Pressure at Meter, In. Hg (Absolute) \_\_\_\_\_
- B. Vapor Pressure of Water at Impinger Temp., In. Hg \_\_\_\_\_
- C. Volume of Metered Gas, Cu. Ft. \_\_\_\_\_
- D. Volume of Water Vapor Metered,  $B \times C / A$ , Cu. Ft. \_\_\_\_\_
- E. Volume of Water Vapor Condensed, Cu. Ft.\* \_\_\_\_\_
- F. Total Volume of Water Vapor in Gas Sample,  $D + E$ , Cu. Ft. \_\_\_\_\_
- G. Total Volume of Gas Sample,  $C + E$ , Cu. Ft. \_\_\_\_\_
- H. % Water Vapor in Sampled Gas,  $100 \times F / G$  \_\_\_\_\_

\* See D on sampling train data sheet, page D-1

### Gas Density Correction Factor

Component	Volume Percent X Moisture Collection	Mol. Wt. =	Weight Per Mole Wet Basis
Water		1.0	18.0
CarbonDioxide	Dry Basis		44.0
CarbonMonoxide	Dry Basis		28.0
Oxygen	Dry Basis		32.0
Nitrogen + Inerts	Dry Basis		28.2
Average Molecular Weight			

J. Density of Gas Referred to Air =  $\frac{\text{Av. Mol. Wt.}}{28.95} =$  \_\_\_\_\_

K. Gas Density Correction Factor =  $\sqrt{\frac{1.00}{J}} =$  \_\_\_\_\_

KVB

Sample Code \_\_\_\_\_

Firm and Unit

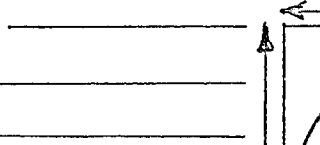
Test No. \_\_\_\_\_

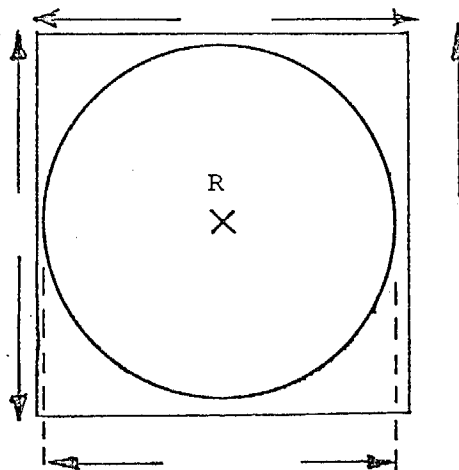
Page F-

Sampling Station \_\_\_\_\_ Date \_\_\_\_\_

### GAS VELOCITY DATA

[illegible]

- A. Average Velocity (Traverse) Ft/Sec \_\_\_\_\_
- B. Av. Velocity (Ref. Point) Ft/Sec \_\_\_\_\_
- C. Flue Factor A/B \_\_\_\_\_
- D. Pitot Correction Factor \_\_\_\_\_
- E. Gas Density Correction Factor \_\_\_\_\_
- F. Corrected Vel.,  $A_x D_x E$ , Ft/Sec \_\_\_\_\_  
or  $B_x C_x D_x E$ , Ft/Sec \_\_\_\_\_
- G. Area of Flue, Sq. Ft. \_\_\_\_\_
- H. Average Flue Temp., °F \_\_\_\_\_
- I. Flow Rate,  $F_x G_x 60$ , CFM \_\_\_\_\_
- J. Flow Rate,  $520 \times I / (H + 460)$ , SCFM \_\_\_\_\_
- 



KVB

DATE \_\_\_\_\_

LABORATORY TEST REQUEST

PROGRAM: C.A.R.B. ORGANIC COMPOUND EMISSION INVENTORY

TEST: FIRM NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

UNIT TESTED \_\_\_\_\_

DATE OF TEST \_\_\_\_\_

PROCESS MATERIAL \_\_\_\_\_ EMISSION TYPE \_\_\_\_\_

REMARKS \_\_\_\_\_

TEST CODE \_\_\_\_\_

SAMPLE CONTAINER		SOURCE OF SAMPLE	SAMPLING TIME	SAMPLING DURATION	SAMPLE VOLUME	
NO.	TYPE				CC.	CU.FT.

DELIVERY DATE \_\_\_\_\_ BY (SIGNATURE) \_\_\_\_\_

RECEIVED BY \_\_\_\_\_

ANALYSIS COMPLETED BY \_\_\_\_\_ DATE \_\_\_\_\_

PROJECTED DATA TRANSFER DATE \_\_\_\_\_

9/76

White - originator

Pink - receipt

5804-8

Yellow - lab

Blue - attached to results

CONVERSION FACTORS AND CONSTANTS

Unless otherwise noted, all conversion factors and constants are at standard conditions of 60°F temperature and 14.7 psia pressure.

<u>TO CONVERT FROM</u>	<u>TO</u>	<u>MULTIPLY BY</u>
grains/cubic foot	parts per million (by volume)	$5.416 \times 10^4 / \underline{M}$
	per cent by volume	$5.416 / \underline{M}$
	milligrams/cubic meter	2289
	milligrams/cubic foot	64.8
	milligrams/liter	2.29
	pounds/1000 pounds air	1.87
	pounds/cubic foot	$1.429 \times 10^{-4}$
parts per million (by volume)	grains/cubic foot	$1.846 \times 10^{-5} \underline{M}$
	per cent by volume	$10^{-4}$
	milligrams/cubic meter	$4.23 \times 10^{-2} \underline{M}$
	milligrams/cubic foot	$1.196 \times 10^{-3} \underline{M}$
	milligrams/liter	$4.23 \times 10^{-5} \underline{M}$
per cent by volume	parts per million (by volume)	$10^4$
	grains/cubic foot	$0.1846 \underline{M}$
	milligrams/liter	$0.423 \underline{M}$
	milligrams/cubic foot	$11.96 \underline{M}$
milligrams/cubic meter	grains/cubic foot	$4.37 \times 10^{-4}$
	parts per million (by volume)	$23.7 / \underline{M}$
	milligrams/cubic foot	0.0283
milligrams/cubic foot	grains/cubic foot	0.01543
	parts per million (by volume)	$836 / \underline{M}$
	milligrams/liter	0.0353
milligrams/liter	grains/cubic foot	0.437
	parts per million (by volume)	$2.37 \times 10^4 / \underline{M}$
	milligrams/cubic foot	28.32
cubic feet	liters	28.32
liters	cubic feet	0.03531
grams	grains	15.43
grains	milligrams	64.8
pounds	grains	7000

# KVB

Sample Code \_\_\_\_\_

Firm and Unit \_\_\_\_\_

Test No. \_\_\_\_\_

Page G- \_\_\_\_\_

Date \_\_\_\_\_

## GRAB AND BAG SAMPLE RESULTS HYDROCARBONS, ALDEHYDES

SAMPLE STATION	Sample Type and Sampling Time	Components	ppm Dry Basis	ppm Stack Conditions	Grains/SCF Stack Conditions	LBS/HR Loss
Location						
Temp., °F						
Humidity, %						
Location						
Temp., °F						
Humidity, %						
Location						
Temp., °F						
Humidity, %						

